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A GROWING ELECTRICAL EXPORT TRADE.

The figures of export trade are now available for the fiscal year of 1906, and are seen to justify fully the sanguine estimates made already in these columns, the total being within $75,000 of our forecast. It appears that the grand total for the year reached no less a sum than $16,655,510 being made up of $8,380,757 in electrical instruments, including telegraphs and telephones, and $8,274,753 in electrical machinery. This compares with a total of $13,057,677 in 1905, made up of $5,648,435 in electrical instruments and $7,409,242 in electrical machinery. Thus there was a gain of $3,597,833, or not far short of 30 per cent. That in itself was remarkable, but even more striking was the gain in miscellaneous minor apparatus, for as will be noted "electrical instruments" now exceed the group of heavy machinery such as dynamos and motors in value. In itself this is healthy and encouraging, but it carries with it the obvious implication of a wider diversification of export, a great many varieties of goods being required to make up such a handsome total.

Unfortunately, the official reports do not analyze closely the data as to instruments so as to furnish the destination, in each class, for 1906, but in the case of electrical machinery this interesting detail is given. It is worthy of note that the United Kingdom was our best European customer, taking $1,219,392; but British North America took $1,943,983; British Australasia, $369,550; British India, $221,662, and British Africa, $181,950. If the other British customers were added, such as those in China and the West Indies, the total sold to customers under the English flag would reach well over $4,000,000, or more than one-half of the total. This is appreciation and friendship of the best kind. Mexico is also an excellent market, taking $1,048,959; while Japan, though not calling for quite as much as in recent years of warlike stress, bought $960,146. With their high protective tariffs, emulative of our own barriers to commercial intercourse, France took only $276,750 and Germany merely $101,192. It is of course to be borne in mind that these figures do not include copper or copper wire, for electrical uses.

Thus far the old year. It is cheering to note that 1907 has started out very nicely. The January export of electrical instruments reached $674,367, as compared with $529,253 in 1906, and the export of electrical machinery attained the figure of $903,082, as compared with $799,939. These are marked gains. A new feature this year for the reports is the geographical subdivision of the instrument class from which it appears that it follows the heavier group as to general destination, the British customer being again very predominant; but it is noteworthy that while the United Kingdom took $114,887 in finer

apparatus, Brazil was second with $110,295. In fact these data are full of suggestion as to opening markets, and should invite to renewed and persistent efforts to secure a share of the world-wide demand now springing up for all classes of electrical goods.

High-Frequency Oscillographs by the Braun Tube.

It is well known that the ordinary oscillograph, of the type originally devised by Blondel, gives beautiful photographic traces of alternating-current wave forms up to frequencies of several thousand cycles per second. Above such frequencies it gives up, partly because of the difficulty in supplying enough light to the sensitive plate for leaving a photographic record, and partly because of difficulties in connection with the residual mechanical inertia of the oscillating system. The Braun cathode ray tube has been used for oscillographic observations at fairly high frequency. The cathode rays have negligibly small mass and inertia, while at the same time possessing a velocity of thousands of kilometers per second, so that inertia difficulties are obviated with this apparatus. The illumination difficulties still persist, however, and new troubles come in. One of these is the absence of sharpness in the cathode ray impact spot on the phosphorescent screen, and the difficulty in providing a uniform velocity along the time axis of co-ordinates, such as is produced by the motor or clockwork which advances the photographic film of the Blondel or Duddell oscillograph. In the oscillographic work on high-potential brush discharges with the Braun tube, published in the *Transactions* of the American Institute of Electrical Engineers about three years ago, Prof. Ryan used a simple harmonic motion of the cathode ray pencil along the time axis, as produced by the magnetic action of a simple alternating current. This is a definite arrangement, but is much less convenient than a uniform motion, because the curve recorded has to be replotted by computation to the usual basis of uniform time, in order to render the results interpretable and comparable.

In the article on page 507 of this number, Mr. E. L. Weber describes another plan for producing a uniform movement of the pencil along the time axis. An inductance is charged, by a battery through the deflecting electromagnets, which magnets provide at least a part of the needed inductance. The initial portion of the charging current—i. e., the current during a period of, say, half the time constant of the circuit or less—rises nearly uniformly. By means of a make-circuit commutator, the charging current of the inductance can thus be made to provide the required uniform deflecting movement of the cathode ray pencil during successive brief intervals. A second commutator on the same shaft admits alternating current into a transformer and sets up oscillations on a high-frequency discharging circuit. The oscillatory potential in the discharging circuit sets up an oscillation of the cathode ray pencil along the transverse axis. The method, as described, appears to work very nicely, but does not admit of obtaining a photographic record of the oscillatory discharge. It merely provides a registration of the envelope of successive wave crests of diminishing amplitude. At the crest of each alternation the movement is relatively very slow, like the slack water period of high tide, so that a record of the line of crests can be secured, when the hurry-scurry of the spot across the zero line is too great to leave an impression. It would seem, therefore, that the plan gives, thus far, no better success than the Blondel oscillograph, when oscillation frequencies of several hundred thousand per second are attempted. The logarithmic envelope of the diminishing amplitude is, of course, something worth obtaining, but it is very little in comparison with the complete oscillatory path. The method of securing approximate uniform movement along the time axis is, however, promising.

A Newly-Discovered Force in Conductors.

Elsewhere we print an abstract of an interesting paper read last week before the American Physical Society by Dr. E. F. Northrup, dealing with what appears to be a heretofore unrecognized force in the interior of conductors carrying current. Last summer Mr. Carl Hering observed a curious and unexpected phenomenon when a relatively large current was passed through a horizontal liquid conductor. The liquid seemed to disobey the ordinary laws of gravity by flowing vertically up the electrodes, and standing at rest with its surface at an angle of 45° or more. He noticed that the forces at play were quite powerful, and that the liquid acted as though the column were forcibly contracted in cross-section. At times this contraction was great enough at certain points to form a deep V-shaped depression in the column, with steeply inclined sides, as though it was being pinched by some mysterious force, and for this reason Mr. Hering has termed the phenomenon the "pinch phenomenon."

This observation was communicated to Dr. Northrup, who made a study of the subject from the mathematical, physical and experimental standpoint, the results of which are contained in the paper abstracted. One line of research dealt with the relation between the magnetic flux which is outside and that which is inside, of the conductor; another with the attraction of currents, and a third with the analogy between the electromagnetic laws and those of gravity for a body of the same form as the conductor. The paper shows that the current elements near the outer surface of the conductor tend to move towards the center across the lines of force which are in the conductor itself, and that they should have this tendency, just as any conductor carrying a current will tend to move across lines of force. This tendency produces a radial pressure in the interior of the conductor from the circumference toward the center. It is shown that there is no resultant force generated on the outside nor at the center, but the accumulation of all the pressures in the other parts of the conductor will act on the central part like a hydrostatic pressure, tending, as it were, to squeeze out the core at the two ends, like the liquid in a rubber tube squeezed by the hand. The quantitative values of these pressures show, among other things, how very greatly these pressures are increased as the conductor contracts, the current remaining the same. This increase, however, is not as great as that of the hydrostatic pressure, and therefore a stable condition is reached in horizontal columns, provided they are deep enough. The paper thus establishes a complete theory of the phenomenon, checked by experiments, on what appears to be a very rational basis.

The author's investigations have furthermore led to other interesting results. He shows, for instance, that it is possible, both from a practical and theoretical standpoint, to produce a continuous fountain of mercury with a continuous or alternat-

ing current, by allowing the mercury to flow out from the top of the center of the core and back to the circumference. Also, that by connecting the central part of one section of the conductor with the circumferential part of the next by means of a tube, the pressures may be added in series to any desired amount, thereby producing very high pressures. The application to indicating and recording instruments at once suggested itself to him. By using as the conductor a liquid made of the very light alloy of sodium and potassium, and covering it with a layer of a non-conducting liquid of only slightly less density, the contraction is greatly increased, thus forming an interesting lecture room experiment. Among other things he described an interesting experiment in which the existence of the flux in the interior of a conductor is manifested by a continuous rotation. The phenomenon, being independent of the direction of the current, is observable with alternating as well as with direct current.

From a theoretical standpoint the results obtained are also of interest. It is shown, for instance, that the lines of force around the original conductor are not changed by this contraction, but that additional lines are created in large numbers in the space through which the conductor has shrunk. From this it seems to follow that more flux encircles a small wire than a large one carrying the same current. Another feature of interest is that for the same current the number of lines of force in the interior of the conductor is always the same, no matter what the size of the conductor. The whole subject seems to be of considerable interest owing to its apparent novelty, to the theoretical deduction and to the possible practical applications.

STUDIES IN ELECTROLYSIS.

Electrolysis is a thing which periodically comes to the front shrieking for attention and then steals away in silence to remain in seclusion until another outbreak is due. There have been as many opinions about it as about ions, and the remedies proposed have ranged all the way from Christian Science stigmatizing it as a mere mortal belief, to the double trolley, which by some is held to be far worse than the disease. It had its innings surely enough at the last Institute meeting with three papers devoted to its case. A few years ago there was much excitement over the possible dangers of electrolysis, and one of the favorite responses was a reference to the probable coming of alternating-current traction as a remedy. Then came sinister suggestions that after all the alternating current might not be so docile as it seemed, and trouble might still be brewing. Mr. Hayden's paper, while it cannot entirely set fears at rest, yet shows very plainly that the alternating current cannot accomplish very much in the way of electrolytic action unless under very favorable circumstances. The net effect found was that with alternating current, of any ordinary frequency at least, the electrolysis is of the nature and magnitude of a small residual phenomenon, generally considerably below one per cent of the electrolytic effect produced by an equal direct current, and for most purposes negligible. In particular, from seemed especially insusceptible to electrolytic attacks by alternating currents, so that the usual dangers to water and gas pipes would be almost eliminated.

On the other hand, it must be admitted that effects considerably larger than any found by Mr. Hayden have been observed in cases where the electrodes concerned differed greatly in area. Under such conditions the residual effect may be considerably increased, though of course they never rise to the severity of direct-current electrolysis. It seems clear, then, that for most practical purposes alternating-current traction will remove the material dangers of electrolysis while not absolutely preventing it. Of far more serious import were the data brought forward by Mr. Knudson. It has, of course, been suspected that electrolytic action might take place in structural steel for various purposes. That such action can and does occur appears very clearly from the paper, but accompanying it is another effect which could not definitely be foreseen—the actual disintegration of concrete blocks through electrolysis taking place around the metallic reinforcing material or its equivalent. As will be seen by reference to the paper, this action was neither slow nor slight. It was amply sufficient to do very grave damage and took place in time measured in weeks rather than years. While the circumstances were not such as normally exist in all buildings, yet the immersion of reinforced concrete in water or moist earth is common enough to create some alarm when the possible results are contemplated. Concrete so far from being of any insulating value under these conditions, becomes practically a conductor, and an electrolytic conductor at that. The dangers of the situation are obvious. Unhappily, the remedies in such cases are far from being as evident as in the case of ordinary street railway operation. The stray currents which infest structural steel are difficult to trace. They are covered up and do their work in quiet. It would be, of course, possible to help by making certain structural elements negative, but there are bound to be corresponding positive elements and it is very difficult to ensure that these shall involve no risks.

Electrolysis is hard to control at best and its worst feature is the usually insidious slowness of its attacks. A big current gives immediate results and therefore can be traced with comparative ease; but a small current backed by a modest electromotive force may go on for years before its damage is really apparent, but in the long run it may be none the less serious. In the use of concrete foundations it is certainly a very important matter to ensure freedom from electrolytic action, and it would not be an unwise or needless precaution to make a pretty thorough electrical survey of a proposed site and to plan the foundations with special reference to electrical security. What with trolley lines, subways and grounded neutrals, the chances are steadily in favor of differences of potential almost anywhere. Experiments with protective coatings, too, are well worth undertaking. As a rule they should not be trusted implicitly, since if they fail at a small area there may ensue localized action of considerable severity. Yet a fairly reliable coating judiciously applied may be able to render the damage practically negligible. More than anything else, it should be borne in mind that one cannot trust to general principles or general remedies in trying to treat electrolysis. Actual investigation of the concrete conditions is the only thing that can be a safe guide in planning remedies, supplemented by good judgment as to the probable effect of remedial changes on the distribution of potential.

United States Government Standardizing Specifications for Incandescent Lamps.

At a meeting of the Association of United States Government Electrical Engineers and the representatives of the leading incandescent electric lamp manufacturers throughout the country, held in Washington, D. C., on February 25, 26 and 27, standard specifications covering incandescent lamps used by the various Departments and Bureaus of the Government service were discussed and mutually agreed upon.

The Association of Government Electrical Engineers, which is an entirely unofficial body, was formed for the purpose of drawing up specifications and making recommendations to the various Departments of the Federal Government, and consists of the following officers and members:

Dr. N. Monroe Hopkins, electrical engineer, Navy Department, chairman; Mr. J. E. Woodwell, electrical engineer, Treasury Department, vice-chairman; Mr. W. C. Allen, electrical engineer, District of Columbia, secretary;

Committee on Standardization of Incandescent Electric Lamps.—Dr. E. P. Hyde, Bureau of Standards; Mr. B. F. Fisher, electrical engineer, Quartermaster's Office, War Department; Mr. J. E. Woodwell, electrical engineer, Treasury Department; Mr. W. Y. Avery, Bureau of Equipment, Navy Department; Mr. P. L. Dougherty, electrical engineer, Treasury Department; Mr. W. C. Allen, electrical engineer, District of Columbia.

In addition to the above, the association comprises the following members: Mr. C. Gleim, United State Capitol; Mr. C. L. Harding, Library of Congress; Mr. H. L. Hibbard, electrical engineer, Bureau of Construction & Repair, Navy Department; Mr. F. T. Powers, electrical engineer, Government Printing Office; Mr. A. S. Riddell, electrical engineer, Post Office Department; Mr. R. H. Chappell, Bureau of Engraving and Printing; Mr. W. B. Hadley, Washington Barracks, War Dept.; Mr. Joseph S. Hill, electrical engineer, Interior Department; Mr. F. E. Cady, Bureau of Standards; Mr. E. E. Gillem, Office Public Buildings and Grounds; Mr. P. J. Cribben, Government Printing Office; Mr. Charles R. Sugg, Government Printing Office; Mr. Thomas H. Humphries, Quartermaster's Office, War Dept.; Mr. George E. Lamb, electrical engineer, War Dept.

The following representatives of the lamp manufacturers' interests were present: Messrs. S. E. Doane, W. H. Roberts, T. W. Frech and J. E. Randall, National Electric Lamp Association; Messrs. Jonathan Camp and I. M. Johanson, Franklin Electric Manufacturing Co.; Messrs. H. B. Rodgers, F. W. Willcox and A. D. Page, General Electric Company; Mr. T. L. Townsend, National Electric Supply Company; Messrs. R. H. Henderson and Walter Cary, Sawyer-Man Electric Co.; Messrs. Wm. Coale, H. B. Ramey and W. H. Pindell, Sterling Electrical Manufacturing Company; Mr. Edw. Campbell, Germania Electric Lamp Co.; Mr. N. L. Norris, Banner Electric Co.; Mr. L. P. Sawyer, Buckeye Electric Co.; Messrs. R. S. Carrick and H. J. Jaeger, Tipless Lamp Co.; Messrs. E. S. Walsh and R. W. Morgan, Anchor Lamp Co.; Messrs. D. H. Garrett and A. C. Garrison, Columbia Incandescent Lamp Co.; Mr. H. C. Rice, General Incandescent Lamp Co.; Mr. A. S. Terry, Sunbeam Incandescent Lamp Co.

Prof. E. B. Rosa, of the National Bureau of Standards, and Dr. Clayton H. Sharp and Mr. Preston Millar, of the New York Testing Laboratories, were also present at the meetings.

The New York Central Bronx Accident.

On the evening of February 16 an electric express, traveling at a high rate of speed on the New York Central Railroad, in the Borough of the Bronx, near Woodlawn, and rounding a curve, left the track and was wrecked, twenty-three persons being killed and about 150 injured. A coroner's jury has been holding inquest and its findings reported this week are as follows: "That the New York Central & Hudson River Railroad Company did not take all the necessary, possible and proper precautions to safeguard its passengers at this point and, consequently, were culpably negligent, and that the responsibility for the existing condition seems to be divided between the construction and operating departments."

In its recommendations the jury said: "We recommend that the New York Central & Hudson River Railroad Company and others operating railroad lines in this State be compelled to reinforce the fastenings of the outer rails on all curves on their lines constructed as the one in question has been proved to have been, by additional spikes, rail braces and increased superelevation, as from the testimony given we feel that unless such precaution is taken similar accidents may be expected.

"We further recommend that until the above strengthening has been completed over curves not so reinforced, the New York Central & Hudson River Railroad and other operating railroad lines be required to lower the speed of trains over such curves to so-called equilibrium speed, or one that is absolutely safe, to protect the lives of passengers and employes, and that instructions to this effect be given those in charge of trains.

"Owing to the lack of information of employes and representatives of the New York Central & Hudson River Railroad as to the determination or exactness of the speed of the electric trains, we recommend that they be compelled to install such recording instruments or make such tests to determine the speed as will enable their motormen to know with reasonable exactness the speed at which their trains are traveling. This information should cover speeds at the three different positions of the controlling lever handle, and be properly tabulated and placed in a prominent position in the cab of each electric locomotive."

In this connection we have received a copy of the following communication addressed by Messrs. Frank J. Sprague and Bion J. Arnold to Assistant District Attorney Smyth:

"For some days you have been conducting an inquiry before Coroner Schwannecke, to ascertain the causes of the disaster of February 16 on the New York Central road, and to place, if possible, the responsibility therefor. From remarks made at the hearing of last Saturday we infer that it is now nearing a close.

"In the course of this investigation it has been suggested that there was some remissness on the part of the Electric Traction Commission which had general charge of preparing the plans for the change from steam to electrical operation. The undersigned were members of that commission, which was in existence for the four years ending last December, and are, therefore, familiar with the details of its work.

"The duties and responsibilities of that commission, while numerous, were not universal. Its outside members were neither officers of the road nor in charge of any of its departments; in fact, during the latter part of its existence its duties were almost nominal, as but few meetings were called during a period of several months. At this time the immediate active work of installation in the electric zone was carried out under the supervision of another body known as the construction committee, of which we were not members, but which was composed exclusively of heads of departments and others in the continuous employ of the railroad, who were presumably in daily touch with the work.

"Furthermore, no matter who designed or installed the electrical equipment, its upkeep and operation, as well as the maintenance of the tracks, the determination of schedules, and the discipline of the operating forces were matters belonging solely to other hands than ours, with whom we were not in touch, and over whom, in our capacity as advisory engineers, we had no control whatever.

"During the investigations, both by the State Board of Railway Commissioners and the coroner's jury, we have been in New York, subject to call at any time; in fact one of us came voluntarily from Chicago to be available if wanted. We are conscious of no neglect of our duties, defect in plans or equip-

ment, or lack of precautionary tests on our part. We stand ready to assume to its full measure any responsibility properly belonging to us as members of the Electric Traction Commission, but in the absence of any request for our evidence we protest against the possibility of being charged with responsibilities which we believe belong specifically to others, or which are the result of an accident, the causes of which are not yet fully determined.

"We have no desire to force ourselves upon your attention, but if it is your wish to arrive at facts in regard to the responsibility of this commission, we suggest that that desire can best be obtained by calling all who are familiar with those facts. If, however, it is now your judgment that any measure of responsibility rests upon this commission, then we demand the right to be heard."

It may be added that the coroner has now accepted a motion by Mr. Smyth to place the responsibility on the railroad company, and not the president and directors. The New York Central has accepted the recommendation made by the coroner's jury by issuing an order limiting the speed of trains in the electric zone. The order states that on straight roads the speed shall not exceed forty-five miles an hour, and on curves thirty-five miles.

Electrolysis from Direct-Current and Alternating-Current Railway Systems.

At the meeting of the American Institute of Electrical Engineers, held in the auditorium of the Engineering Societies Building, New York City, on March 1, three papers were presented dealing with the general subject of electrolysis from railway systems. The first of these papers, by Mr. J. L. R. Hayden, dealt with alternating-current electrolysis. The second, by Mr. A. A. Knudson, described observations made on the electrolytic corrosion of iron and steel in concrete; while the third, by Mr. George I. Rhodes, gave some theoretical notes on the reduction of earth currents from electric railway systems by means of negative feeders.

The paper by Mr. Hayden gave the details of a series of tests showing the electrolytic action of alternating current at different frequencies and different densities upon iron and lead immersed in diluted solutions of such salts as may be expected in the ground. It was found that the action varies greatly with the chemical character of the electrolyte, but rarely exceeds one-half percent of the action of an equal direct current. In general, lead is more attacked than iron, and the latter shows greater erratic behavior than lead, due probably to the existence of a passive state. The electrolysis does not depend appreciably upon the current density and it increases with the decrease of frequency. It was found that by superimposing a small direct current upon the alternating current the electrical corrosion could be made negative. That is to say, the total corrosion was reduced below the value which would have existed with no current flowing. It seems that a very small increase of the negative half wave over the positive half wave of the current is sufficient to make the negative half wave completely reverse the action of the preceding positive half wave. A direct current equal to 1.5 per cent of the alternating current completely protects lead against electrolytic action by 25-cycle current.

In his paper on electrolytic corrosion of iron and steel in concrete, Mr. A. A. Knudson reported the results of some laboratory experiments made upon blocks of cement immersed in water and in which were embedded wrought iron pipe, .1 ampere being passed through them continuously for 30 days. It was found that the concrete was gradually disrupted while the iron pipes suffered a loss in weight and exhibited evidences of electrolysis when the blocks were broken open. On one block which was immersed in salt water, but was not subjected to current, no corrosion took place. The author concluded that while concrete protects steel from ordinary corrosion, it is not an insulator but is just as good an electrolyte as any of the soils found in the earth.

The paper by Mr. Rhodes was largely mathematical in nature. It showed the relative economy of different return feeder systems in reducing stray currents from electric railways. On the basis of the assumption that all resistance offered to the current flowing from the tracks to earth is in the contact between the rails and the earth, it was shown that the best results with a given number of feeders can be obtained with no connection to the rails at the power station when the distance between the feed points is twice the distance from the powerhouse to the first point, and from the last point to the end of the line; while when the rails are connected to the bus-bars at the power house, the best results are obtained when the distance from the power station to the first feed point is equal to twice the last point to the end of the line. Insulating the negative bus-bar greatly decreases the leakage current in any case. With a single feeder to the middle of the line and no other connection between the bus-bars and rails the leakage is independent of the amount of copper used, and is equal to 4.8 per cent of the leakage current with the bus grounded at one end and no copper in the negative circuit. With two feeders the leakage is reduced to 1.2 per cent of the value which exists when the bus-bar is grounded. Very little gain may be expected from the use of more than two feeders.

In opening the discussion on the papers Mr. L. B. Stillwell remarked that there can be no doubt that in many of our cities and towns damage is being done by electrolysis from railway systems, although the damage might be prevented by reasonable application of known principles and methods. The duty of the engineer is to exercise his influence to secure a realization of the fact that an ounce of prevention is worth a pound of cure and to induce the executive management of the railway companies to take timely precautions to protect the interests of the telephone and water works systems.

Mr. F. N. Waterman criticised the paper by Mr. Knudson on account of the fact that the tests were not conducted under conditions as they actually exist, so that the results are of little practical value and no definite conclusions can be derived from them.

Mr. Paul Winsor said that although the electric railways in Boston are well bonded and a considerable amount of copper is used in the return circuit, much trouble has been encountered from electrolysis on account of the fact that the Harvard power station is surrounded by a marsh of salt water, beyond which, about a mile away, is the first car track. Careful surveys have been made of the water mains and the telephone cables and numerous negative feeders have been connected to the rails, and the trouble has been practically eliminated. Insulating joints ar used in the water mains; some of the joints are of rubber and some of wood. Recently experiments were made in operating the railway on the three-wire system, using the track as the neutral.

The method of carrying out the three-wire experiments at Boston and the results obtained therefrom were described by Mr. John W. Corning, who stated that one of the machines in the power house was connected in series with the remaining equipment and a certain section of the overhead trolley wire was joined to the negative terminal of the machine. No change was made in the feeder sections, but insulating joints were placed in the trolley wire at the crossing points of positive and negative sections. It was found that with 1,100 amperes being used on the three-wire system the drop in the rail was reduced to 17 per cent of that which existed when an equivalent current was used on the two-wire system. In some cases the drop in the rail return was practically wholly wiped out when use was made of the three-wire connection.

Mr. H. G. Stott read a communication by Mr. S. M. Kintner, giving the results of experiments made about three years ago which were fully in agreement with the results recorded in Mr

Hayden's paper. It was found that for iron and steel there is in general little or no alternating-current electrolytic loss greater than the normal chemical corrosion, but for lead, such as employed in cable sheaths, there is a slight loss which varies from ¼ to ½ of 1 per cent of what would be obtained from direct current under similar circumstances. The current densities assumed by Mr. Hayden are very unlikely to exist in actual service conditions. The writer expressed the opinion that alternating current, in so far as practical service conditions are concerned, will not cause any electrolytic damage to pipes that would be of consequence.

Mr. Calvert Townley remarked that the public has been led to believe that electrolysis is a terrible thing, going on secretly and mysteriously all the time. The condition, however, is not serious at all, provided proper precautions are taken to minimize the troubles. The engineer should take pains to state the facts and not to belittle the dangers. Telephone companies have adopted the plan of connecting the lead sheath of the cables where the cable is positive to the return circuit with a metallic conductor, so that the difference of potential between these two conductors is practically eliminated. While the tendency to flow is not entirely removed, it is decreased to a sufficient degree so that corrosive action from electrolysis is practically nullified.

Prof. G. F. Sever stated that the proper way to handle the electrolytic problem is for all parties interested to study the situation carefully and together and to endeavor to reduce the difficulty wherever it appears. Investigations made at Columbia University in 1904 on electrolytic action with 60-cycle current indicated that the corrosive action of alternating current on sub-surface metal structures may be assumed to be negligible.

Prof. A. F. Ganz explained that electrolytic action by alternating current may be attributed to the fact that the corrosive effect of the positive half wave of current is not entirely reversed by the reconstructive action of the succeeding negative half wave. The reason for this lies probably in the fact that a portion of the products of electrolysis produced by the current during the positive half cycle diffuses away so that the negative half wave of current does not quite reverse the action of the positive half wave. Since these rates of diffusion vary greatly with different materials the per cent of direct current electrolysis produced by an alternating current varies greatly with different electrolytes. On this theory the effect of increasing the frequency would be to decrease the electrolysis, as the results of the experiments recorded in Mr. Hayden's paper show to be the case.

The discussion was closed by Dr. C. P. Steinmetz, who remarked that iron rails and both gas and water pipes can very readily be protected by the use of negative feeders, so that the electrolysis is not serious in connection with them. It is in the case of the lead cables of the telephone system that there is the greatest danger of electrolytic action. Protection for the cables is perfect and absolute, if the cable throughout its whole extension is made more negative than the surrounding ground. In the case of alternating current an electrolytic corrosion amounting to ½ of 1 per cent of the direct current would be destructive to the lead cables in a very short time. As pointed out in Mr. Hayden's paper, it is possible under all conditions to protect the lead cable by superposing the direct current upon the alternating current in the return circuit. It is true that such direct current would destroy metal at some point. By using the superposed direct current the electrolysis is shifted from the lead sheaths to the iron rails, but the rails are thoroughly capable of withstanding the minute corrosion. Instead of specifying a certain minimum potential drop against ground in the return feeders, which has been done by certain German engineers, it would be more sensible to specify that the underground iron structures which are to be protected must be made negative, and at all time maintained negative against the rail.

Power Transmission Voltages.

At its first meeting in the Engineering Societies Building on February 27, the president, Mr. G. Herbert Condict, announced that the New York Electrical Society was then holding its 265th meeting, being the oldest electrical body in America. The paper of the evening, "Power Transmission Voltages of To-day and To-morrow," was presented by Prof. Harold B. Smith of the Worcester Polytechnic Institute. By means of lantern slides Prof. Smith showed the past developments and present condition of power transmission systems. He described and illustrated transformers which had been constructed for giving electromotive forces up to 500,000 volts. The coils of these transformers were arranged in the form of disks separated from each other and from the core by considerable space which is occupied by oil as the insulating medium. The transformers were of the core type, the disks being given such internal diameters that the space between the coils and the core increased uniformly from the center disks to the edge coils, which possessed the maximum difference of potential to the core. He illustrated also a 1,000-kw, 100,000-volt, core-type transformer which had been built for experimental purposes by one of the manufacturing companies according to the author's designs. The terminals from this transformer were brought out through insulators of pyramidal form. Views were given of a three-part transmission circuit insulator which had withstood electromotive forces as high as 250,000 volts. Prof. Smith explained that experimental observations seemed to indicate that as the voltage between two cylindrical conductors approaches the value necessary to the formation of corona, the effective diameter of the conductors in regard to their capacity is increased with increasing voltage, and the current which passed to and from the two conductors could be represented as flowing through a circuit joining the two conductors consisting of a condenser and a resistance in parallel.

The discussion of the paper was opened by Mr. H. A. Lardner, who, in commenting upon the great value of the work of investigation conducted by Prof. Smith, remarked that almost all of the trunk line railways are at present seriously considering the electrification of their routes. Such electrification will necessitate long-distance transmission, and extremely high voltages will be necessary. Thus the demand for high voltage transformers and transmission circuit insulators will certainly increase rather than decrease. Even at the present time electricity is being transmitted from Niagara into the very heart of the coal regions, where it is able successfully to compete with electricity generated from the cheapest of coal.

Mr. G. Herbert Condict stated that recent investigations had shown that the undeveloped deposits of peat in the south possess great possibilities as the source of fuel for long-distance transmission systems. It is estimated that electricity can be generated from peat as a fuel at a cost much less than at present is charged for electricity from hydro-electric stations. He expressed his intention of presenting data concerning peat at a subsequent meeting of the New York Electrical Society.

Research Fellowships in Engineering.

The University of Illinois has extended and strengthened the field of its graduate work in engineering by recently establishing ten research fellowships in the engineering experiment station. These fellowships have an annual value of $500, and are open to graduates of approved universities and technical schools, both American and foreign. They must be accepted for two consecutive collegiate years, at the expiration of which period, if all requirements have been met, the Master's degree will be granted. Preference will be given to men who have had some experience in practical engineering work outside of college. The appointments will be made upon the rec-

ommendation of the station staff of the engineering experiment station, and upon the approval of the faculty of the graduate school and the president of the university.

The engineering experiment station, it may be explained, is a department connected with the College of Engineering. It was established in 1903 for the purpose of carrying on investigations along various lines of engineering, and for the study of problems of importance to professional engineers and to the manufacturing and industrial interests of the state. The work of the station and the college is closely related, the heads of the several departments of the College of Engineering constituting the station staff. The investigations are carried on by the members of the staff directly, sometimes by a fellow as graduate work, sometimes by a member of the instructional force of the college, and frequently by special investigators belonging to the station corps.

The various laboratories of the station and the college offer exceptional facilities for investigational work, being well equipped with the most modern apparatus. During the past four years about $300,000 has been appropriated by the state legislature for the maintenance and extension of this equipment, and it is believed that the same liberal policy will be continued.

By offering these research fellowships of $500 and throwing them open to graduates of both American and foreign universities, the station hopes to secure a picked body of men imbued with the true spirit of genuine investigators who will do graduate work of high grade. It is expected that valuable results will accrue to the station, and that a body of experts will be developed, some of whom may be attached later to the regular corps of station investigators. A circular giving full information will soon be issued, and can be obtained upon application to the director of the Engineering Experiment Station, Urbana, Ill.

The County Council Electrical Energy Plan for London.

Attention has been called in these columns from time to time to the plans for supplying the London area with electrical energy. The Parliamentary Committee of the London County Council has now submitted for approval a draft of the bill which will be introduced in the next session of Parliament to enable the Council to supply electrical energy in London, and in a large area of the surrounding districts. The opportunity will be taken by the finance committee to present an exhaustive report upon the financial bearings of the scheme. In this report, which is signed by Lord Welby, the committee point out that the scheme of the present bill differs in very many particulars from that submitted to Parliament last year. In the first place, in deference to the views expressed by the select committee, a larger scheme has been prepared, and the powers, if conferred upon the Council, will carry with them an obligation to furnish a supply of electricity on certain conditions, whereas last year's proposals were merely permissive. The total capital outlay is estimated approximately at $22,500,000 ', be spread over a period of about seven years. This would provide for the erection of a generating station at Barking, and the necessary transmission system and switch centers. The sum includes $1,000,000 for interest to be charged to capital account during the period of construction, and additional amounts for working capital and for letting out motors and other apparatus on hire. Power will be sought in the bill for the incorporation in the electric supply scheme, if the Council so decides, of the Council's generating station now in use for its tramways, but the cost of this, approximately $4,250,000, is not included in the above figures, as the expenditure has already been incurred, and there will only need to be an adjustment in respect of it between the tramway and bulk supply accounts; nor do the figures include capital which may be required for the purchase of undertakings in the future. The scheme also provides for the purchase by the Council of the undertakings of electric lighting companies within the area when they shall become purchasable under the Electric Lighting Act, 1888. The committee do not think it necessary or possible to estimate the extent of the liabilities which may be incurred by the Council in the future in connection with that matter, but they point out that whenever purchase takes place, it must involve the raising of large additional capital. So far as the outlay upon the new system of generation and supply is concerned, the amount and the rate of progress of expenditure may be to some extent beyond the Council's control, inasmuch as the Council will be under obligation to make provision for meeting all reasonable demands for supply.

The committee state that they had examined from a financial standpoint the estimates prepared by the experts of the working expenses of the proposed undertaking at various stages of development; these estimates appeared to have been prepared with care, and there was no feature in them to which they took exception. Interest on capital outlay had been calculated at an average rate of 3½ per cent, and repayment of debt was provided for, on the basis of cumulative annuities, within the periods of the estimated life of the various parts of the works, the equated period working out at about 32 years. Turning to the revenue side of the account, the committee recognized that it was not possible to frame any certain estimates of revenue. The experts by their tables showed that if all the energy generated was sold there would be a small surplus of revenue over all charges when two-fifths of the new generating station was in full operation. The committee feared that during the early years, while the business was being got together and the undertaking gradually brought into operation, some charge on the rates must be looked for, and the Council must face this probability. The highways committee were advised that there was difficulty in avoiding this by fixing higher charges at first for energy supplied, as the charges must be fixed low from the outset, in order to attract business. The whole conception of such an undertaking was that cheap electricity could be obtained only by generating on a very large scale, and this necessarily involved that the volume of business should reach a certain level before the undertaking paid its way. The experts looked for a rapid growth in the use of electricity for motors, and it was expected that when the scheme was fully developed, by the year 1915 or thereabouts, there would be a substantial surplus sufficient to secure the financial stability of the undertaking. The estimates did not, however, contemplate any relief to the rates, the scheme having been prepared on the lines of giving the consumer the utmost benefit possible in cheapness of price. The committee, while recognizing the necessity of fixing as low a price as possible, thought sufficient margin should be allowed to afford all reasonable safeguards against any change in the rates except in the very early years of development.

The scheme proposes that the undertakings of borough councils shall be taken over at the amount of their outstanding debts, as this is considered to be a more acceptable basis than to attempt to arrive at the value of each undertaking on the basis of capital cost, less depreciation. The finance committee, however, point out that as a rule loans for electric lighting have been spread over periods in excess of the estimated life of the works, and the borough councils are required to provide out of revenue or reserve funds for any renewals which may arise before the expiration of the loan period. Any reserve or renewals fund should, therefore, pass to the Council, if the Council were to assume the outstanding indebtedness on these undertakings. There were obvious difficulties connected with the proposed basis of transfer owing to the different circumstances and financial conditions of the various local undertakings, and further consideration might lead to some modifications. It would, perhaps, be possible for the Council to leave the distributing part of the undertakings in the hands of the borough councils, the Council concerning itself only with generation and supply in bulk.

The committee point out that, as the Council has already laid down its policy with regard to the electricity supply for London, it only remained for them to endeavor to make clear to the Council, so far as financial considerations are concerned, the probable results of that policy. Considerable financial risks are inseparable, they say, from the establishment of an undertaking of this nature and extent. Under the scheme which has been adopted the financial responsibilities and risks will fall on the ratepayers of London, while the ratepayers of all the large districts outside London within the area of supply will be entirely immune. The large addition to the Council's capital requirements which the scheme involves must tend to affect the raising of money by the Council for all its services. The Council has adopted the policy which involves these financial responsibilities because, the committee understand, it is apprehensive of the results which might follow the establishment of a vast monopoly in the hands of a company.

Hungarian Patent Rules.

The Hungarian Patent Office has published an abridged English translation of its rules, from which the following is abstracted:

A patent cannot be allowed for an invention: 1. The working of which is contrary to a law, or ordinance or to public morals. 2. Which relates to arms for war purposes, explosives, ammunition, fortifications or ships of war necessary for increasing the belligerent power of the Austro-Hungarian army, the navy or the royal Honvéd, provided the Minister of Commerce enters an opposition against the grant of such patent. 3. For scientific theorems or principles as such. 4. For articles serving for human and animal nourishment; for medicines and articles produced by chemical processes; the process employed in making such articles can however be patented.

The invention is not regarded as new if at the time of the application for patent: 1. It has been made so known by published printed publications or other reproductions, that it can be used by persons skilled in the art. 2. It has been made so known by public working or by exhibition that its employment by persons skilled in the art has been rendered possible. 3. It has previously formed the subject matter of a patent.

The invention is regarded as new notwithstanding publication or working, if since its last publication or working up to the application for a patent for it, a term of one hundred years has elapsed. It has to be determined by treaties made with foreign States whether an official publication published in a foreign State deprives the patent of novelty.

The description must answer the following requirements: 1. It must enable persons skilled in the art to make the subject matter of the invention on the basis of such description without any application thereof. In particular the description must not contain any misleading ambiguities, nor must it keep secret anything relating to the means, the mode of working or the particular operations necessary for successfully carrying the invention into practice, nor must it name means or devices, which are more expensive or have not the same effect.

2. It must numerate in one or more claiming clauses, what is considered to be new and what the applicant wishes to have protected by patent. If there be two or more claiming clauses and the substance of the invention does not consist in the matters separately pointed out in the several claiming clauses but in the entirety of the matters pointed out in all the claiming causes or in groups of such claiming clauses, this circumstance has to be particularly mentioned. Defects of the claiming clauses cannot be remedied by other parts of the specification.

3. It must be accompanied by the drawings necessary for its understanding and drawn in permanent form and in such form as will be prescribed by ordinance, and, if it should prove necessary, also by models or samples.

4. It must be provided with the signature of the applicant or his representative. Up to the publication of the application the applicant can make alterations in the description and the claiming clauses. The Patent Office decides as to the influence of such alterations upon the priority of the application.

The title of the invention may be proposed by the applicant, but the Patent Office will not be required to adopt such title.

CURRENT NEWS AND NOTES.

THE LINCOLN ELECTRICAL SHOW.—The electrical show which is being promoted for Lincoln, Neb., by the Lincoln Gas & Electric Light Company, under T. B. Mitchell, manager of the commercial department, has all the available space taken by exhibitors and promises to be a great success.

N. E. L. A. CONVENTION.—The executive committee of the National Electric Light Association at a meeting in Washington last week decided to hold in that city, at the New Willard Hotel, the next annual convention on June 4, 5, 6 and 7. There will also be an electrical exhibition beginning on the evening of June 3. The exhibition and the meetings will be held in the spacious ballroom or top floor of the hotel. The month is one of the most beautiful at the national capital, and it is believed there will be a very large attendance.

TWENTY THOUSAND MESSAGES.—With the object of influencing the action of Congress on the La Follette "Hours of Service" bill, the railway telegraphers of the country flooded the House of Representatives last Friday, March 1, with some 20,000 telegrams, protesting against any emasculation of the bill. Such a deluge made the representatives pretty anxious and busy, and it is said that as a result the measure is even more liberal than the men expected or than the railroads can possibly stand. Senators were also included in this unwonted distribution of telegraphic favors.

A COLD BATH.—The electrical committee of the municipality of Bath, England, has unanimously recommended the town council to sell the lighting plant. After eleven years of operation, it has proved a decided failure, and the "gross profits" are not now adequate for meeting the interest and sinking fund charges on an investment of $810,000. Mr. Ernest Schenck, with electrical energy from the Somerset Electrical Power Company and the Western Electrical Distributing Corporation, is to take over the plant from the city, paying the corporation every cent of its outlay, and offering $100,000 as a bonus for a perpetual franchise. He offers an immediate reduction in rates for street lighting, etc., and the transfer will bring an estimated reduction in local taxation of 5 cents on the pound. This incident is regarded as a disagreeable cold bath for "municipalites." The local ratepayers are enthusiastic over the change to private ownership.

NATIONAL ELECTRICAL CODE.—Mr. C. M. Goddard has issued as secretary of the Underwriters' National Electric Association a bulletin of several pages embodying the suggested changes in rules, etc., to be taken up at the meeting to be held in New York City March 27 and 28. The pamphlet contains also the reports of the committees on slow-burning weatherproof wire; street railway property and rolling stock; double and single-pole switches; variable speed motors; theatre wiring; rheostats; series lamps; insulating joints; outlet boxes; condulets; ground connections; fuses in neutral of three-wire systems; electric signs. There are also a number of miscellaneous suggestions. A large amount of important material is thus offered for consideration. Mr. W. H. Blood, Jr., insurance expert on behalf of the National Electric Light Association, has just issued a notice to its membership inviting active interest and co-operation. Mr. C. J. H. Woodbury, secretary of the National Conference on Standard Electrical Rules, also announces a meeting of the Conference in New York City, at the Edison Auditorium on March 29 to consider the proposed changes and reports above noted.

ELECTRIC HEADLIGHTS.—Under the influence of union labor a bill has been passed in the Texas House of Assembly and will probably pass the Senate requiring every railroad in the State to equip all of its locomotives with electric headlights.

FORT WORTH LIGHTING.—The city of Fort Worth, Texas, has a municipal lighting plant and the local newspaper cartoonist amuses himself with illustrations of its lights of "one candle-power" and the manner in which the citizens grope around in the darkness of their own creating.

GIFT TO RUTGERS.—It is announced that a gift of $25,000 made by Andrew Carnegie for the science and electrical courses of Rutgers College has become available. The gift, which was offered some time ago, was contingent upon the amount being duplicated. A new building will be erected for the housing of the department.

VIENNA ELECTRIC FOUNTAIN.—The city of Vienna has installed a fine electrically lighted fountain in the Schwartzenbergplatz. Underneath the fountain, in a cemented chamber, there are placed twenty-seven reflecting lamps, capable of producing seventy different luminous and colored effects on the waters of the fountain.

INTERURBANS IN TEXAS.—The Texas Legislature has passed a bill giving interurban electric railway companies the right of eminent domain. The bill was drawn in the interest of the proposed interurban electric railway about to be built between Houston and Galveston. It will be 51 miles long, with spurs to one or more pleasure resorts on Galveston Bay.

LONDON AGAINST M. O.—A special cable dispatch from London of March 2 records a great victory by the people of that city over the advocates of municipal ownership. No less than 42 seats have been gained, giving the conservative forces, apparently, 76 seats out of 118, in place of 34. The recent extravagances of the "Progressive" party and the startling increases in taxation have literally scared the citizens, and this election is their revolt and protest against any further municipal ownership enterprises.

CORRESPONDENCE SCHOOL INSTRUCTION.—In an address delivered at a celebration to commemorate the fifteenth anniversary of the International Correspondence Schools of Scranton, Pa., the president of that institution, Mr. T. J. Foster, stated that the school has 75,000 installment accounts, and that the income last year was $4,200,000. In the course of an address the mayor of Scranton stated that the institution employs 1,200 men and women, and during the past 15 years has given instruction to nearly 1,000,000 people.

FIXING PRICE OF ENERGY.—A bill has passed the Indiana House, and will be favored in the Senate which will affect all the public utility companies in the state. The act gives City Councils the right to fix the price of gas, water, electric light and other public utilities by ordinance, from time to time. A City Council may, under the provisions of the measure, name whatever price it deems fair, and if the rate is not satisfactory to the company furnishing the utility, it has the right to appeal to the court for a hearing.

ITALIAN EXPENDITURES.—The *Bollettino delle Finanze* states that the Italian Minister of Posts and Telegraphs has presented to the Chamber of Deputies a bill providing for the expenditure of $5,000,000 on measures for improving the postal, telegraphic and telephonic services of the country. The following are among the proposed items of expenditure: $40,000 on letter boxes, $200,000 on experimental pneumatic postal services in Rome, Naples and Milan; $2,400,000 on telegraph materials, and $1,640,000 on the extension of the telephone service.

A DAYTON CAMPAIGN.—A part of the very enterprising campaign for increase of business which has been carried on by the Dayton Lighting Company for the past two years has been a recent letter addressed by F. M. Tait, general manager, to various customers, calling attention to the fact that the company has an illuminating engineer and offering his services to any customer who is not sure that he is getting the best possible results from his lamps as now arranged. Mr. Tait reports that this circular brought many replies.

ELECTRICAL SALESMEN'S ASSOCIATION.—The Electrical Salesmen's Association held a special meeting at Chicago at the Grand Pacific Hotel, Tuesday evening, February 26. A new constitution and by-laws were reported by the committee and adopted. This constitution provides for the organization of sections in different cities of the country. The meeting was presided over by President C. A. S. Howlett. Mr. Francis Raymond, Old Colony Building, Chicago, is secretary. After the business session, an informal discussion of some points in salesmanship was participated in by most of those present.

ELECTROCUTION IN JERSEY.—On March 1 death by electricity as a penalty for murder became the law in the State of New Jersey, but there is no money for carrying into effect the provisions of the act, which says that such executions must take place in an isolated buliding. There is pending in the present Legislature a bill appropriating $10,000 for this building, but the fate of the appropriation is still in doubt; in fact, there is little sympathy with killing by electricity in the State. The present law was passed last winter at the request of a New York newspaper. The law was robbed of effect by the failure of the Appropriation Committee to provide funds for carrying it out.

STEVENS INSTITUTE.—At the recent annual dinner of the Alumni Association of the Stevens Institute of Technology President Humphrey said that the Institute needed several things, among them an electrical laboratory to cost $100,000, a machine shop to cost $50,000, a students' hall and increased endowment. He also said that the $45,000 which Stevens paid as an inheritance tax after the civil war, despite the fact that other institutions escaped the charge, is being demanded back by legal process of law. The demand has been made now for thirty years without getting the money, but there is still hope. All told the Institute could spend $700,000 very easily.

A. I. E. E. AT SCHENECTADY.—A very large audience on February 28 listened to a lecture by Mr. W. S. Moody on "Thermal Problems of Static Transformers," given in the regular course of the Schenectady branch, American Institute of Electrical Engineers. After briefly outlining some of the conceptions of early transformer designers, the speaker gave a most comprehensive comparative exposition of the many methods used to keep the temperature of large and small transformers within practical limits. His descriptions were illustrated by charts and followed by a series of lantern slides and the hour or more taken by his talk was one of the most instructive in this season's course.

NETWORK OF JERSEY TROLLEYS.—It is stated that the Pennsylvania Railroad is fostering a plan to link all resorts on the Jersey coast from Sandy Hook to Cape May by trolley, so that within three years it will be possible to go from New York to Sandy Hook by steamer and ride without change of cars to the southernmost point of New Jersey. Engineers for the Shore Fast Line, in which the Pennsylvania Railroad is heavily interested, are already making surveys for a southerly extension by which the line to Ocean City will be carried to Wildwood, Sea Isle City, Avalon and through a string of growing resorts farther south to Cape May. Cars are to be running over the new coast route to the Cape May terminus early in the summer of 1908.

STAND AND DELIVER.—All the uses of electricity are not yet fully appreciated. A negro porter was having his "blood tested" in a Bowery museum last week, when he suddenly discovered that the handles of the machine he was holding were charged heavily with electricity, and the current was so strong that he could not relax his grip. While thus powerless he alleges that he was made to promise to "shell out" if he was released. He did so, and had to give up 20 cents, all he had. This was the story he told to Magistrate Sweetser in the Essex Market Court. The proprietor and cashier, respectively, of the museum were held in $1,000 bail each for examination, charged with extortion.

GLOWER LAMP.—A patent was issued February 19 to F. M. F. Cazin on a glower lamp of a type which was first patented by the same inventor July 18, 1894. The glower consists of a core of metal or metals of the ruthenium-osmium class, and preferably of an alloy of two or more such metals. This core is then coated with an alloy of a metal of less affinity for oxygen than the core metal. One of the forms of glower consists of a conducting core of spiral form and of a layer or layers of metals plated on the core and modifying the simple cylindrical surface, which surface is coated, as previously stated, with a metal of less affinity for oxygen than that of the core metals, such as tungsten, rhodium, thorium, etc. These latter metals may have their surface coated with a layer of their own oxides.

EDUCATION IN NOVA SCOTIA.—Advices from Halifax, dated March 2, state that a new epoch in the industrial history of Nova Scotia was forecast by Premier Murray when he introduced in the House of Assembly the Technical Education bill. The measure provides for the establishment of an institute of technology in Halifax, with subordinate technical schools in industrial centers. Under the provisions of the bill, existing mining schools will be made more efficient and placed under control of the director of technical education, while the principal of the central college will have supervision over the entire system. The plan calls for an expenditure of $100,000 for buildings, equipment, etc. The objects of the college, as outlined, are technical training and scientific research, and the central college will be a degree conferring institution with a staff of experts as professors, who will form the governing board.

THE CHICAGO A. I. E. E.—A very enthusiastic and profitable telephone meeting was held by the Chicago branch of the American Institute of Electrical Engineers on February 26. Mr. S. P. Grace, of Pittsburg, chief engineer of the Central District Printing & Telegraph Company, presented a paper illustrated with lantern slides on the "Telephone Wire Plant." The paper was full of valuable data on comparative values of standard "conference" cable and other sizes of cable and overhead lines, showing the talking limits of various kinds, both with and without Pupin loading coils. He gave lantern slide illustrations of the standard construction used by his company, which was very complete as to details. The publication of this paper in full will be looked forward to with much interest by all telephone engineers. The paper was discussed by Messrs. S. G. Larned, E. F. Norton and others of the Chicago Telephone Company.

A *SINGLE-PHASE TRANSMISSION LINE.*—Among other companies which have recently extended single-phase transmission lines to neighboring towns for furnishing light, heat and power is the Massillon (Ohio) Light, Heat and Power Company. This company has a line to Canal Fulton, a village of 1,200 inhabitants, ten miles distant. The line is operated at 10,000 volts. The poles are located on the highway; the step-up transformer is in the power station at Massillon, and the step-down transformer on a pole at Canal Fulton. The transformers are 50-kw. Thirty-foot poles were used. Besides the single-phase, 10,000-volt transmission line there is a 6.6-ampere direct-current arc circuit. The pole has a 4-pin cross arm. The 10,000-line occupies the end pins. The distance between pins is 18 in. The wire on the 10,000-volt line is No. 8 copper and on the arc circuit No. 6. The company also has some other shorter lines to settlements in the neighborhood of Massillon.

CENTRAL STATION INCREASE IN CHICAGO.—The connected load of the Chicago central station companies increased 25,000 kw in 1906. This does not include 30,000 kw supplied to the surface and elevated railroads. The Commonwealth Electric Company is now supplying some power for the Northwestern, the Lake Street and the Metropolitan Elevated roads as well as considerable power to the street railways. The motor load increase includes 225 elevators with a total of 2,375 hp; 11,600 hp in miscellaneous motors; 1,000 hp for storage battery charging purposes, 825 arc lamps and the equivalent of 281,000 16-cp incandescent lamps. The great Fisk Street power station has been increased about 48,000 kw and 24,000 kw more is being put in. This plant, our readers will remember, was designed for an ultimate capacity of 200,000 kw. Twelve hundred electric signs have been put in on the rental form contract in which the Chicago Edison Company was one of the pioneers.

ST. LAWRENCE POWER.—A measure has been introduced in the New York Legislature which incorporates the Long Sault Development Company and permits it to dam the St. Lawrence River and construct locks, canals and power houses to develop power from the waters of that river and "to improve the navigation." It authorizes the commissioners of the Land Office to grant to the company such lands under water as may be necessary for that work on payment of a reasonable compensation. The bill provides that this company shall have a perpetual existence. It may erect and maintain dams, canals, reservoirs, gates, sluices, bulkheads, piers, flumes, abutments and whatever other appurtenances may be necessary to develop water power and generate electrical power, on or adjacent to the south shore of the St. Lawrence, near Long Sault or Barnhart's Island, or on either island, and between them and the shores of the river and Shiek's Island, but not across the international boundary. These works may be operated in connection with similar works now erected or to be erected on the Canadian side. The bill also authorizes the maintenance of bridges across the river, with the right to charge tolls on them. These rights are granted on the express condition that the corporation erect a lock or locks as required by the United States and provide free of charge electricity to operate them.

REPORT ON TELEPHONY.—It is stated from Chicago that last week Mayor Dunne and his municipal ownership adherents had an unpleasant surprise when Mr. Walter F. Burgess, the telephone expert engaged by a council committee at the Mayor's solicitation to gather facts on telephone conditions in Europe, made his report, showing the regulations, restrictions and wage scales developed under municipal ownership there, greatly to its discredit when compared with the data Mr. Burgess supplied on private ownership in this country. In every country named by Mr. Burgess rates were lower than in the United States, but the service, he declared, was so much inferior that there was no comparison. The report showed that the wages of operators, laborers and linemen in these countries were ridiculously low. The Glasgow system, he said, was sold by the municipality to a private corporation at a loss to the city of $200,000 after citizens had refused to subscribe for the service or to support it. The French people, according to Mr. Burgess, have become so disgusted with their system that they have formed an organization the sole object of which is to get tolerable service. In a publication issued by it the American service is held up as an example of what could be done in France under other conditions. In Great Britain, Mr. Burgess says, the government and municipal telephones are operated at a great loss.

Generating Station and Sub-Station of the United Electric Company, Lemoyne, Pa.

THE generating station of the United Electric Company, Lemoyne, Pa., is built on the south bank of the Susquehanna River, directly opposite the city of Harrisburg and just below the Market Street bridge. The power house, which has been recently remodeled, supplies electricity for lighting to Mechanicsburg, Shiremanstown, Camp Hill, New Cumberland, Riverton, Wormleysburg, Lemoyne, West Fairview, Enola and Marysville, and in addition supplies the lines of the Valley Traction Company, with which the United Electric Company is closely associated. The railway lines of the latter company run to Harrisburg, Camp Hill, Shiremanstown, Mechanicsburg, Boiling Springs, Carlisle, New Cumberland, White Hill, Lemoyne, Marysville, Wormleysburg, Fairview and Enola.

The general layout of the station equipment is shown in the plan view given herewith. The boiler room contains four 264-hp Babcock & Wilcox water-tube boilers and one 250-hp Aultman & Taylor boiler, four of which are built into batteries and three of which have their furnaces fitted with Wilkinson stokers, the other two boilers being hand-fired. The fuel used is bituminous slack, which is brought to the station over the Cumberland Valley Railroad and which is worth about $2.50 per ton. Although there is an abundance of river coal available, the load on the station and the boiler capacity are such as to preclude its use at present. Were more boilers installed river coal could be used to advantage. A street railway gauge track runs right through the boiler room in front of the boilers, so that if necessary coal could be brought to the station by this means. As it is there is a spur leading from the Cumberland Valley Railroad, whose lines are on a bluff directly back of the station and ending just outside the boiler room at some height above the boiler room level. The cars on this trestle merely dump their load of coal into bins directly beneath from which it is taken to the boiler room in barrows and weighed. The feed water for the boilers is taken from a suction well which is connected with the Susquehanna River. A Marsh boiler feed pump is used, the water first passing through a Webster open feed-water heater. A brick stack furnishes natural draft for the hand-fired boilers, the others, fitted with stokers, using forced draft.

Each of the boilers is connected to a 12-in. steam main in the boiler room through 8-in. loops, and connected to this main steam header is a 6-in. auxiliary header, which passes over the front of the boilers and forms a complete loop with the main header running the length of the boiler room. From three points on the main header, 10-in. steam pipes lead to the generator room, a 6-in. pipe also leading from the main header to feed a Harrisburg tandem-compound engine, which is belt-connected to a 300-kw, 550-volt generator. All of the main steam pipes after passing through the partition separating the boiler and generator rooms descend into the basement under the generator floor, the connections to the individual engines being made through the floor by means of long goosenecks as shown in the engravings.

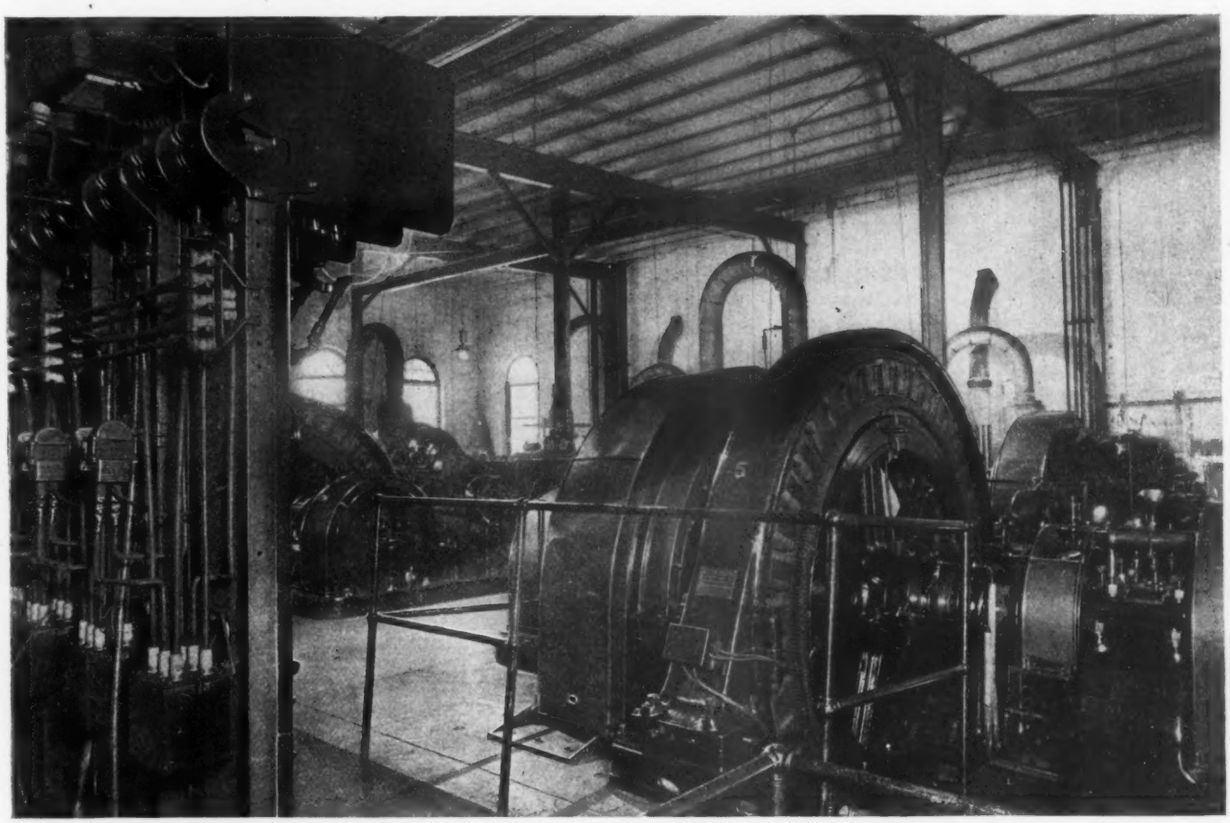


FIG. 1.—VIEW OF INTERIOR OF STATION OF THE UNITED ELECTRIC COMPANY, AT LEMOYNE, PA.

The equipment in the main generator room consists of two Pennsylvania Iron Works cross-compound, four-valve, engines, direct-connected to two 250-kw, two-phase, 2,200-volt alternators; one engine of the same make, direct-connected to a 300-kw, 550-volt Westinghouse direct-current generator; one Harrisburg cross-compound engine, direct-connected to a 300-kw, Crocker-Wheeler, 550-volt direct-current generator; a Bullock motor-generator set, a Gould storage battery outfit and a 550-volt motor-generator set. In another part of the station is a 250-hp Westinghouse vertical engine, belt connected to a 250-kw, 550-volt generator, and two 300-kw rotary converters running inverted; 550-volt current being fed in the direct-current side and 370-volt current being taken out of the alternating-current side. Each alternator has its individual exciter driven by belt from the shaft.

Each of the 250-kw units is fed with steam through a 6-in. pipe, and each of the 300-kw units is fed through a 7-in. pipe. All of the Pennsylvania engines have a 4-in. connection from

the steam main into the receiver between the high and low-pressure cylinders. The exhaust line runs along the partition wall and crosses the engine room basement at right angles to this line to the condenser. Paralleling this latter branch of the exhaust line is another of the same size, which is connected with the former through a gate valve. The size of the exhaust line is 10 in. at the start and 18 in. at the free exhaust. A 12-in. exhaust main from one of the 250-kw units makes a right-angle connection with the main exhaust where the size changes from 10 to 16 in. The other units have more direct connections. Both of the exhaust lines pass through closed heaters before passing to the condenser, and the 4-in. feed-water supply is caused to pass through these heaters before entering the open-feed water heater in the boiler room. The latter heater is fed with a 6-in. exhaust connection from the condenser room. The vertical engine exhausts to the second main exhaust line and is supplied with steam through an 8-in. steam line connecting with the first 10-in. steam line leading from the header in the boiler room.

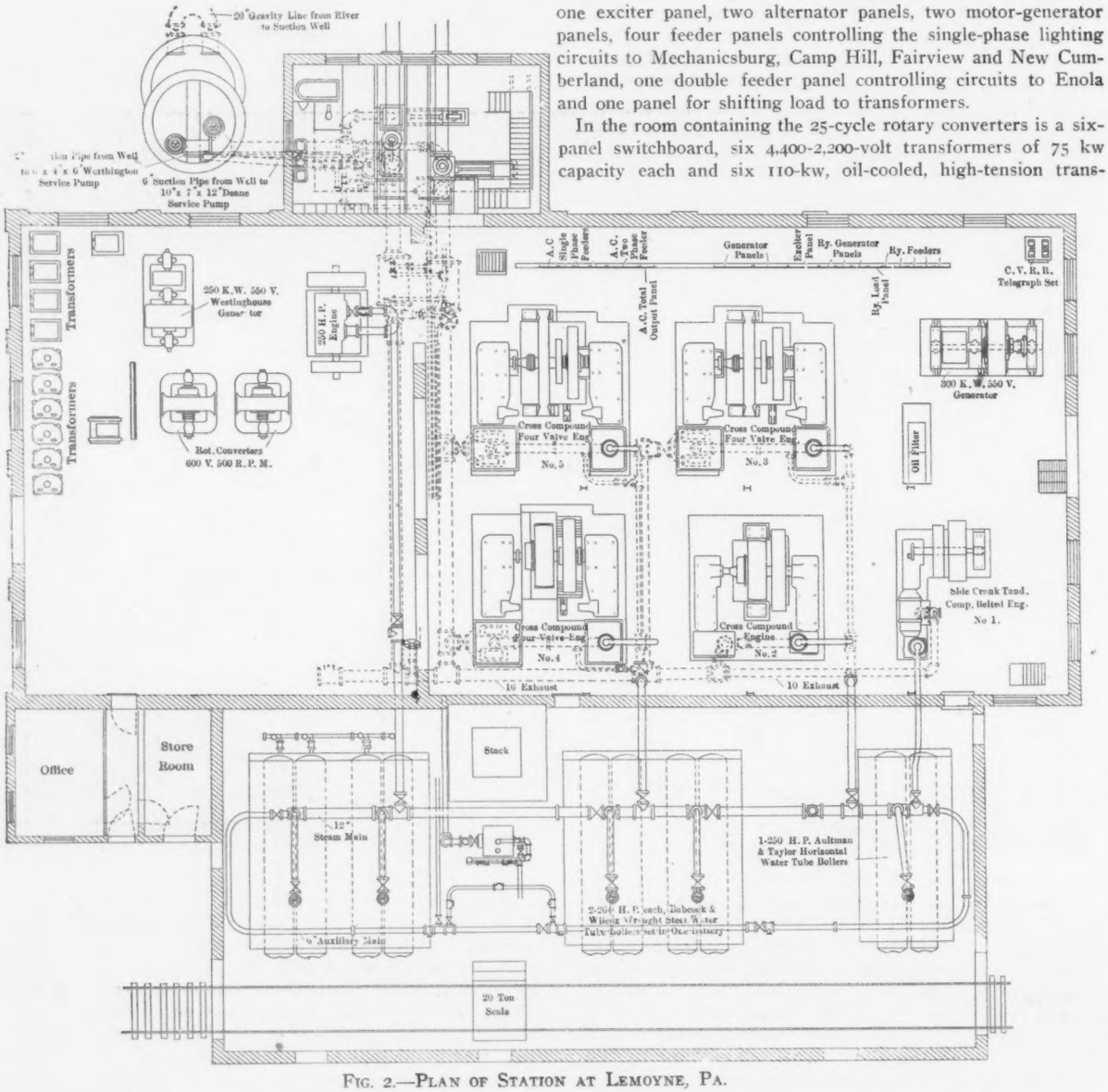

20" Gravity Line from River to Suction Well
6" Suction Pipe from Well to 10" x 7" x 12" Deane Service Pump
Transformers
Transformers
250 K.W. 550 V. Westinghouse Generator
250 H.P. Engine
Rot. Converters 600 V. 500 R.P.M.
A.C. Single Phase Feeders
A.C. Two Phase Feeder
Generator Panels
Exciter Panel
Ry. Generator Panels
Ry. Feeders
C.V.R.R. Telegraph Set
A.C. Total Output Panel
Ry. Load Panel
300 K.W. 550 V. Generator
Cross Compound Four Valve Eng. No. 5
Cross Compound Four Valve Eng. No. 3
Oil Filter
Slide Crank Tand. Comp. Belted Eng. No. 1.
Cross Compound Four-Valve Eng. No. 4
Cross Compound Engine No. 2
10 Exhaust
10 Exhaust
Office
Store Room
Stack
12" Steam Main
1-250 H.P. Aultman & Taylor Horizontal Water Tube Boilers
10" Auxiliary Main
20 Ton Scale

Fig. 2.—Plan of Station at Lemoyne, Pa.

In the condenser room adjoining the generator room are two 14 by 20 by 24-in. Deane condenser pumps, one 6 by 4 by 6-in. Worthington service pump, one 10 by 7 by 12-in. Deane service pump, wash basins, closets, bathroom, etc. A 20-in. gravity line runs from the Susquehanna River to a large suction well outside the power house and from this are taken a 6-in. suction pipe to the Deane service pump, a 2½-in. suction pipe to the Worthington service pump and a 14-in. injection line for the condensers.

A view of the main switchboard is shown in Fig. 7. This contains 24 panels and extends along the river wall of the station. Beginning from the right-hand side of the engraving the panels are arranged as follows: One railway feeder panel for Marysville; one railway feeder panel for Fairview; one railway feeder panel for Harrisburg, one railway feeder panel for New Cumberland, one railway feeder panel for Mechanicsburg, one total load panel followed by three storage battery panels. Then follow one General Electric generator panel, one Crocker-Wheeler generator panel, two Westinghouse generator panels, one exciter panel, two alternator panels, two motor-generator panels, four feeder panels controlling the single-phase lighting circuits to Mechanicsburg, Camp Hill, Fairview and New Cumberland, one double feeder panel controlling circuits to Enola and one panel for shifting load to transformers.

In the room containing the 25-cycle rotary converters is a six-panel switchboard, six 4,400-2,200-volt transformers of 75 kw capacity each and six 110-kw, oil-cooled, high-tension transformers in which the 370-volt current is stepped up to 13,200 volts for transmission to Trindle Spring and Carlisle, where sub-stations are established.

Adjoining the power house is a small one-story building for housing the storage battery. This was furnished by the Gould Storage Battery Company and consists of 264 cells, type S-613 in type S-619 lead-lined tanks. The battery is charged by a 1,500-amp. Bullock booster and discharges 1,000 amp. on the peak.

The battery house has excellent ventilation and illumination.

The floor is of vitrified brick set in pitch and the lead-lined battery tanks are mounted on the usual petticoat insulators, supported on stringers, and these latter are again supported on in-

FIG. 3.—VIEW OF STATION SHOWING OUTGOING FEEDERS.

sulators mounted on vitrified tile set in sulphur. The tanks are installed in rows with ample aisle space for the removal of a tank if it should become at any time necessary. The outfit follows the typical Gould construction. The sides of the battery tanks are extended to the line of the bus-bars and are rabbitted

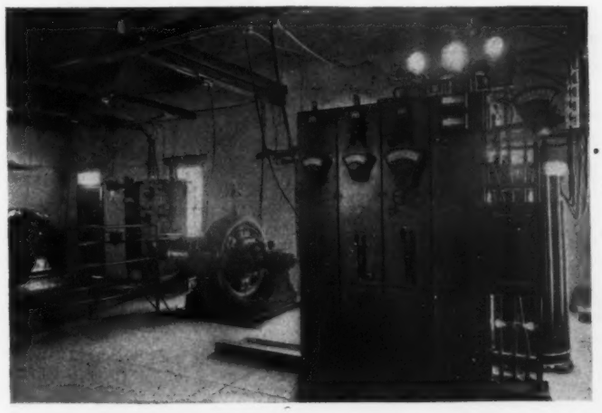


FIG. 4.—VIEW OF INTERIOR OF CARLISLE SUB-STATION.

on the inner edge to carry glass covers. These keep dust and foreign matter out of the cells and prevent to a very great extent loss of electrolyte by evaporation and spraying. The usual counter e.m.f. Gould booster forms a part of the outfit.

FIG. 5.—ROTARY CONVERTERS IN POWER HOUSE.

The 75-kw motor-generator set in the main generator room is driven from the 550-volt railway bus-bars during the day and delivers 2,200-volt alternating current for day lighting load. After midnight the set is reversed, taking 2,200-volt alternating current and delivering 550-volt direct current, which is used for an all-night car running between Harrisburg and the railroad shops at Enola.

The high-tension lines running to Trindle Spring and Carlisle are of aluminum, equivalent to 00 wire in carrying capacity. In the sub-station at Trindle Spring is a 300-kw rotary converter and also in the sub-station at Carlisle there is a rotary of the same size, with the necessary switchboard equipment. The 13,200-volt, three-phase current is stepped down to 370 volts in oil-cooled transformers for use in the rotaries at both sub-stations. The sub-station at Carlisle was formerly a steam-driven gen-

FIG 6.—TRINDLE SPRING SUB-STATION.

erating station and the original equipment is still held in reserve in case of mishap to the transmission line. The output at both sub-stations is used for railway purposes entirely.

The company has about 60 enclosed arc lamps connected to its circuits and over 10,000 incandescent lamps. The contract with Mechanicsburg calls for 48 arc lamps at $64 per year each and 30 32-cp incandescent lamps at the rate of $16 per year each.

FIG. 7.—MAIN SWITCHBOARD IN POWER HOUSE.

Both alternating and direct-current day circuits are maintained in all the towns supplied. The entire lighting load is about 350 kw and the rate is 10 cents per kw-hour. The rate for energy for motors varies from 2 to 10 cents per kw-hour. All of the lighting is done with alternating current taken from

2,200-volt pole transformers having a 110-volt secondary, and from one phase of the two-phase circuits. Incandescent lamps are renewed free of charge and all customers are connected through a meter. Needless to say all lines are overhead. The feeders to Enola are three-phase at a potential of 4,400 volts. This is stepped down in the railroad yards for arc lighting, shop lighting and motor work. Fig. 3 shows the character of the transmission lines leaving the station.

The station equipment is primarily intended for street railway service and incidentally for commercial and residential lighting. The district covered embraces a very fertile section of the Cumberland Valley where the chances for a lighting load of any proportions are very slim. The territory is sparsely settled and were it not for the interurban railway system an electric light station could hardly be operated on a profitable basis.

The business of furnishing electricity for lamps and motors to small communities requires excellent management to make it pay, although many well-managed small companies are doing well in spite of the handicap of an uneconomical power station. Railway companies with their more economical plants can, of course, do better than small companies; and where the road is of sufficient size to require alternating-current transmission at high voltage, or low voltage for that matter, there is usually a power house of such size and equipment as to be able to generate electricity for very much less per kw-hour than a small country lighting station. By this means it is possible to supply electricity to small villages along the route which of themselves are too small to support an independent lighting station. The sub-stations of the company are so located that little lighting can be done from them. Carlisle has a separate electric light company and the only other towns of any size between Harrisburg and Carlisle are furnished with electricity over individual feeders from the station at Lemoyne. Should, however, the territory along the route build up it will be an easy matter to tap the transmission lines to supply whatever load may be obtained. The officers of the company are as follows: M. C. Kennedy, president; W. L. Ritchey, secretary-treasurer; C. M. Davison, auditor; J. F. Boyd, purchasing agent, and C. H. Bishop, superintendent. J. M. Reich is the chief engineer and W. P. Rice the chief electrician of the station. The Valley Traction Company has the same officers.

New Electric Light Plant of the Spokane & Inland Empire Railroad Company.

Some two years ago or more Jay P. Graves and associates decided to enter the electric light, heat and power field in the city of Spokane in connection with their traction business, at that time in its infancy. Accordingly, they had all the available power sites of any reasonable size and within a reasonable distance of Spokane examined.

The engineer making this examination reported that everything considered, the site now being developed was the best that could be had, and steps were immediately taken to acquire the property. The site selected is about ten miles down the Spokane River from the City of Spokane and at a point where the river cuts through a deep granite rock gorge. It so happens that at this point the surface of the river at high water is about 320 ft. wide, while at low water the channel is on the west side of the river about 100 ft. wide and approximately 20 ft. deep, while on the east side of the river there is a rock bottom approximately 200 ft. wide, which stands above the water at low water. This made an ideal location, inasmuch as the power house could be placed in the deep part of the stream and the dam which would have to be about 225 ft. on the crest, could be built practically on dry rock. The canyon was deep enough so that a dam 60 ft. high could be built and at the highest water not overflow the rock contour. By building a dam of this height, a lake was created about four and one-half miles long, having a superficial area of about 400 acres, the advantage of such a development, of course, being that with the storage capacity a peak load on the lower power plant can be handled at least twice as large as the normal flow of the river would admit without storage.

Having acquired the necessary property, the developing company decided in April, 1906, to proceed with the actual work and transferred the property to the Spokane & Inland Empire Railroad Company, and this company employed the firm of Messrs. Sanderson & Porter to be designing and constructing engineers, and made arrangements with Wm. F. Zimmerman to enter the employ of the Spokane & Inland Empire Railroad Company and to act as consulting engineer for this work. Accordingly, plans were immediately made and the work started about July 1, 1906.

The work was started by preparing the rock on the east side of the river for the reception of the dam, carrying on at the same time the coffer work to divert the water from the deep part of the river on the west side, so that the power house could be built before the construction of the dam was commenced. The design admits of passing the water through the draft tubes while the dam is being erected. Granite rock, a fine quality of gravel and a fine quality of sand were found on the side hills and within a few hundred yards of the work, thus making ideal conditions for concrete and cyclopean work. The coffer dams were built largely of timber cut off the land to be flooded, and the water was stopped out by means of log

FIG. 7.—BIRDSEYE VIEW OF NINE-MILE POWER SITE.

mats covered with hemlock boughs and sealed with fine sand and gravel put in position by hydraulic jets. The concrete plant, having a mixing capacity of 500 yards or more a day, was located on the east side at an elevation above that of the dam crest and directly below the sand and gravel pits, so that the sand reaches the sand bins by gravity, and the gravel is hydrauliced so as to be properly washed into a screen, which screen in turn delivers it to the gravel bin; the gravel being of a very fine quality, the mixture now being used is one, two and five. The machine shop, steam plant and camp is located on the bench or plateau on the west side of the development; the camp being large enough to accommodate about 350 employes, special buildings were built for the engineers, the foremen and the workmen, and the mess house is arranged so that the foremen have their meals in a separate room from the workmen.

The centrifugal pumps are used to keep the interior to the cofferdam dry. At each corner of the rectangle forming the cofferdam is located a jib crane with hoists, and these four cranes cover the entire power house site. Spoil banks are made along the sides of the river so that the excavated material is drawn as short a distance as possible. A large amount of material is also dumped into the river just above the up-stream coffers. The power house will be approximately 110 ft. across

the stream, 87 ft. high from low water mark and approximately 85 ft. from the up-stream walls of the power house to the down-stream walls. The power house is designed to accommodate four units of 5,000 hp each, the initial installation being two such units. The wheel pits will be open flumes closed by head gates, each unit consisting of four 42-in. adjustable bucket type of wheel built by the Holyoke Machine Company, of Holyoke, Mass. The shaft of these wheels will run directly through the dam wall and be connected by a flange coupling to a 3,750-kw, three-phase, 2,200-volt, 60-cycle alternator, the shaft of which will carry an exciter of sufficient size to excite three units. The turbine speed regulator will be placed between the generator and the dam wall. The switchboard, electrically operated, to which nothing but the low-tension wires are to be connected, will be placed in the center of and on the down-stream side of the power house, so that the switchboard operator will have full view of each and every machine. A traveling crane, hand-operated, will cover the entire length of the dynamo floor. The height of the building will be such that the second floor, 30 ft. above the dynamo room floor, will be used for all the switchboard apparatus; both high and low-tension switches and their connections being made on this floor.

FIG. 2.—VIEW OF EXCAVATION OF POWER HOUSE AT NINE-MILE POWER SITE.

The dam wall will be so constructed that the space between each set of retaining piers may be used for the transformers, there being one set of raising transformers, raising the voltage from 2,200, the machine voltage, to 60,000, the line voltage adopted. These transformer rooms will be built entirely of concrete, access to them being through fire-proof iron doors.

The transformer rooms will drain directly to the tail-race and the transformers will have an oil drain with a valve which can be operated from the dynamo room, discharging the oil into the tail-race, and to be used at any time in case of fire. A gantry floor covered by a hand-traveling crane, will extend over all the transformer rooms, also partly over the turbine pits, so that the turbine wheels, as well as the transformers, can be placed or raised out of their positions by a single traveler and delivered to the gantry floor; the gantry floor will be on a level with the roadway leading to the power house. The main water gates will be double leaf sliding gates, operated by rack and pinion hoist, motor driven. Each turbine chamber will be supplied with an auxiliary filling valve.

The power house building will be steel construction, brick filled. The dynamo room floor and the switchboard floor, however, will be reinforced concrete. The dam extending from the power house to the east bank will be of cyclopean concrete work. There will be a water stop wall on the west side of the building 85 ft. high from low-water mark in the tail-race to the west bank. At the present time the power house is well under way, the excavation having been completed and the concrete work being well along. It is expected that this plant will be in operation on or about December 1, 1907.

The energy from this plant will furnish light, heat and power for the City of Spokane, the Inland Empire Company having a broad franchise in the city. It will also be used to develop the country through which the lines of the Inland Empire system operate, furnishing power as far south as Moscow and possibly farther. The Inland Empire Railway system owns other power sites which will be developed when the power from this development shall have been used. The work of construction is in direct charge of F. M. Sylvester.

The Inter-Pole Railway Motor.

BY C. A. MUDGE.

THE electric railway apparatus of to-day comprises some of the most reliable and ingenious pieces of mechanism in existence. The motors, probably, show the highest development of any particular part of the system, and represent the expenditure of more thought than any other single piece of apparatus included in the complete system. The platform controller is a substantial piece of apparatus and is reliable if properly treated. It does not, however, represent the ideal of design and disposition of material that is obtained in that form of controller adapted to be placed under the car in which the operating currents are kept as far as possible from the passengers, and which occupies a minimum of space above the floor of the car. The other pieces of apparatus have been developed to a state of perfection which their practical operation has demonstrated as being sufficiently good for the severe service required of them.

In any railway proposition of whatever magnitude, after the system has been decided upon, a great deal of time is spent in the selection of a proper motor to fulfill the given service conditions, and the engineer whose duty it is to select this piece of apparatus is interested only in obtaining the particular motor which will perform the service on the most reliable and economical basis. The enormous number of details entering into the design and construction of the simplest type of railway motors is seldom appreciated by the users of this type of apparatus, and very often not well understood by the engineers whose duty it is to take charge of them after they have left the factory of the maker. The rapid strides being made at present in the development of this seemingly perfected piece of apparatus hardly allows the designer, who is responsible for its creation, a peaceful night's sleep for fear that in the morning he will find that his latest attempt has been superseded by a more efficient piece of apparatus while he was asleep. The engineer who is thoroughly alive to the opportunities presented for improving this valuable piece of apparatus never gets through with one design before he sees where it could have been improved in some details.

There has been one very important and decided improvement in the direct-current railway motor within the past two years which will give this system decidedly more flexibility and will allow it to share some of the valuable features of the alternating current system. The direct current system, due to the inherent limitations of the direct current, as well as to commutation and occasional flash-over troubles, has been considered by some as

having reached its limit of development. If we would be allowed to use a higher potential some of the limitation and necessarily complicated parts of the system would disappear. By utilizing in the motors a well-known principle, although only recently placed in actual practice, in which the armature reaction in the commutating zone is neutralized by a field independent to the main field of the motor, but bearing a definite relation to the armature field, we are able to produce results which are sure to prove of the most vital importance to the entire direct current railway system. By utilizing this feature, the motor shows a flexibility between its speed and torque characteristics, that we are not accustomed to see in a series motor, and our present ideas of a single efficient speed for a given torque will have to be somewhat modified in considering railway motors which embody the inter-pole feature in their design. Those who are interested in the design of this type of apparatus can appreciate the fact that no fixed relation between armature and field ampere turns need be strictly adhered to when we include inter-poles in our motors. If an independent feature is incorporated in the motor to take care of the commutation irrespective of the value of the reactance voltage, the inductions, the length of air-gap or the quality of the brush, and operates automatically, we at once increase the flexibility of the motor to an extent which almost places a new type of apparatus at our disposal.

In order to take full advantage of the use of inter-poles in railway motors, we will have to modify the proportions of the present type of motors, in some respects, inasmuch as we will be able to place more copper on the armature, reduce the air-gap to the minimum, determined only by mechanical considerations, shorten the commutator, either through the use of more brush arms or a brush having higher conducting qualities than those at present in use, lengthen the armature core, increase the length of the pole arc, work the copper in the field at higher initial densities, and make other alterations.

In any motor, of the plain series type, there must be a definite relation between the the ampere turns on the poles and the maximum ampere turns which can be allowed on the armature if the motor is to commutate satisfactorily. In an inter-pole motor this relation does not need to be kept fixed; for instance, we do not require the fixed ratio of 2:1 field to armature ampere turns as is the case in one of the most popular 75-hp motors on the market to-day. We can make this ratio 3:1 at starting, in order to get a very high torque per ampere and then reduce it to 1:1 or even less when we are over the accelerating period. This means that for a motor of this size we will be able to get a practicable variation in efficient operating speed of at least 25 per cent, and still retain the full load torque, or we can get an efficient variation in speed of 50 per cent at one-third full-load torque. If our bearings would allow us to run on a 1/16-inch air-gap instead of a 3/16-inch gap, as we are required to do on a great many railway motors at present, we could get a considerably greater torque per pound of material than we have to be satisfied with at present. The length of air-gap does not play the part in satisfactory commutation in an inter-pole motor, that it does in the plain series type. We may cut it in half or even less and still not get into trouble at the commutator. The advent of ball bearings promised improvements along this line, but they have not stood up under practical tests on railway motors, at least those which have come under the writer's notice. The oil and waste bearings that are being used so extensively at present are a great improvement over the wick and grease bearings, but they do not allow us to run any closer to the pole pieces. Bearing designers should get busy in the railway motor line and help solve this problem.

In this age of copper famine there are, I believe, very few railway managers who appreciate the fact they are getting the actual use of only about 50 per cent of the copper in their railway motor commutators, carrying the other 50 per cent around as dead weight just to lend stability to the other half. Quite a large bank account at present copper prices and drawing no interest. With inter-pole construction we need not let high reactance voltages worry us, and if mechanically desirable we may use four brush arms without danger of running into commutation difficulties. Also since the brush need not have commutating qualities, good collecting virtues alone being required, we may use a brush designed especially for great carrying capacity and of very low resistance, such as those known to the trade as "Omega No. 15." If proper attention is paid to the quantity and quality of mica between segments, or, better still, if the mica is cut down below the surface of the commutator, the cutting quality of the brush may almost be dispensed with and attention paid only to its collecting capacity. In inter-pole machines coming under the writer's attention, in which the commutators and brushes have been kept of present standard proportion, a decided decrease in temperature has been noticed, pointing conclusively to the fact that different proportions may have been used in designing the commutator. Certainly, by eliminating, through the use of inter-poles, the sparking at the brush, using more arms and a lower resistance brush, the dimensions of the commutator may be materially decreased for a given maximum temperature rise.

If we shorten the commutator, we can use this space for extra armature iron, which we will need for keeping tooth inductions down, since it is desirable to place as much copper on the armature core as possible, which means more slots. We will not be able to use too wide a slot, and the advantages of getting a high slot efficiency by using a five-division coil should not be worked to extremes as it is good policy to keep the amount of armature iron passing under the inter-pole as near a constant quantity as possible, which result cannot be attained when the armature slot is too wide. Comparing the armature slots of two motors of about 240 hp, A. I. E. E., nominal rating, the inter-pole motor slot was only 85 per cent as wide but 17½ per cent deeper than the plain series motor, and had 20 per cent more slots than the latter. Both slots had an efficiency of 50 per cent, i. e., one-half copper, and represented about the limit in efficient design for both motors.

The main pole arc depends upon the armature diameter, the pitch of the armature coils, the amount of field distortion allowable, the length of air-gap, and the number of armature slots, and should not subtend an angle greatly exceeding 65 degrees. The dimensions of the inter-poles depend upon the total flux they are to supply, whether two or four of them are used in a four-pole motor, whether they lie in the plane of the armature shaft, what the position of their exciting coils is in relation to the armature. In general, the width of the pole face should be from 1¼ to 1½, the tooth-pitch for four-pole machines with three division armature coils, although the other proportions of the motor may alter these figures somewhat.

By having a flexibility between the field and the armature, we can adjust the motor to the service requirements more readily than if there is always a fixed relation between these two parts. We may, for instance, work the field very hard during acceleration, thus getting the maximum torque output per ampere input, after which we will have to ease up on the field so that it will not become too hot. This method of operation will result in a saving of energy. By using a very heavy field for starting, we get high counter electro-motive forces at low speeds, just what we want to keep the losses in the starting resistance low, then when this resistance is cut out, we have an efficient means of speed variation by field control without cutting in any of the starting resistance.

One error that designers of inter-pole motors are liable to fall into is the placing of too many turns in the armature coils for the smaller size motors. This they are liable to do in order to keep the number of commutator bars down so that the manufacturing cost will be a minimum. This produces high voltage between bars, and on heavy loads the great armature reaction distorts the field so much that on some portions of the commutator the potential between bars becomes bunched and may exceed the safe limit, and flashing over is likely to occur. A good rule to follow is not to try to take advantage of all the benefits to be gained by the use of inter-poles, but work up to the limits gradually.

Investigation of High-Frequency, High-Potential Oscillating Discharges by Means of the Braun Tube.

BY E. L. WEBER.

THE experiment described in this article was devised and conducted by Mr. Geo. M. Albrecht and the writer at the Electrical Laboratory of the University of Minnesota for the purpose of obtaining a direct graph of the wave form of a high-frequency, high-potential oscillating discharge, such as is obtained from a Thomson-Tesla transformer. As a mechanical oscillograph is entirely unable to trace wave forms of a frequency of over 10,000 oscillations per second, use was made of the electrostatic and electromagnetic deflections of the cathode ray, which are best exhibited in the Braun tube.

To obtain a direct graph of the e.m.f. of an oscillating wave by means of the Braun tube, it is necessary to have the deflection along one axis of the screen vary directly with this e.m.f., while the deflection along the other axis varies directly with the time. The first can readily be obtained by electrostatic deflection of the cathode beam. To obtain the second the building-up phenomenon of a current in a conductor may be used.

The equation of a current flowing in a conductor is as follows:

$$I = \frac{E}{R}\left(1 - \epsilon^{\frac{-Rt}{L}}\right);$$

or,

$$t = -\frac{L}{R}\log\left(1 - \frac{RI}{E}\right);$$

or, considered from the time-constant, τ, where the current attains about .6 of its full value,

$$\tau = -\frac{L}{R},$$

where L is the self-induction and R the resistance of the circuit.

If we plot the curve

$$I = \frac{E}{R}\left(1 - \epsilon^{\frac{-Rt}{L}}\right)$$

with t as the independent variable and I as the dependent variable, R and L being constants, it is seen (Fig. 1) that the portion OB of the curve OC, lying between O and D (D being the value of τ), is practically a straight line; in other words, the current within these limits varies directly as the time.

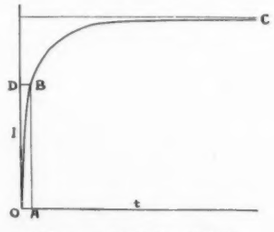


FIG. 1.—CURRENT CURVE.

To have this time of building-up small, τ must be small. Hence, L must be small and R large, since

$$L = \frac{4\pi n^2 \mu s}{10 l},$$

to have L small we must have n, μ and s small and l large. Hence a long, thin magnet of few ampere-turns and with no iron core should be used.

In order to have the frequency of the oscillations not too great, a large capacity is needed in the oscillating circuit; for in a balanced circuit

$$N = \frac{1}{2\pi\sqrt{LC}},$$

where N is the frequency, L the self-induction and C the capacity.

To obtain this capacity a large number of high-tension condensers were constructed. These were made of alternate layers of tin-foil and glass, dipped in a suitable dielectric. The total capacity of these condensers was about .2 microfarad, and they were found to carry safely 30,000 volts.

Without going in detail into the various methods employed, and the difficulties encountered during the course of experimentation, we will pass directly to the final method employed and the results thereby obtained.

Fig. 2 shows diagrammatically the apparatus used and the connections for same. T represents the Braun tube and P a concentrating coil used to give the spot a sharper outline and make it more susceptible to electromagnetic deflections. The tube is excited by the double Holtz machine, R.

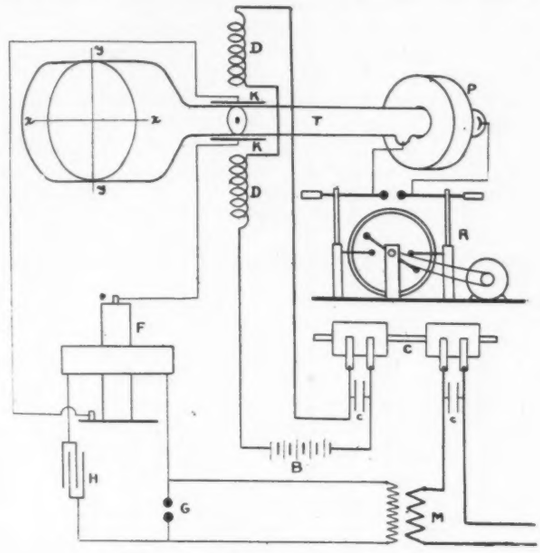


FIG. 2.—ARRANGEMENT OF APPARATUS.

The deflection along the y axis is produced electrostatically by charging two tin-foil covered plates, $K\,K$, from the secondary of the Tesla transformer, F.

In the oscillating circuit, F is the Thomson-Tesla transformer, H the high-tension condensers, G a spark-gap and M a static transformer, capable of stepping up to 30,000 volts.

The deflection along the x axis is produced electromagnetically by sending an interrupted current through the deflecting coils, $D\,D$, from the battery, B.

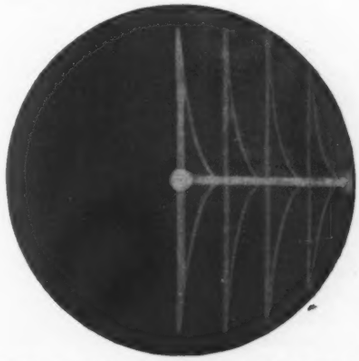


FIG. 3.—WAVE FROM TWO SIMULTANEOUS DEFLECTIONS.

In order that the electrostatic and electromagnetic deflections may occur simultaneously a double commutator, C, was used. One cylinder of the commutator is fast to the shaft while the other cylinder is capable of any desirable angular adjustment; $c\,c$ are condensers used to absorb sparks formed at the brushes.

The action, then, is as follows: An impulse of direct current

is sent through the primary of the transformer, *M*. The secondary of the transformer, then, charges the condenser, *H*, and oscillations are produced at the gap, *G*, which pass through the primary of the transformer. These are reproduced in the secondary winding and impinge a charge upon the plates, *K K*, thus producing rapidly oscillating deflections of the cathode beam along the *y* axis.

By properly adjusting the commutator, *C*, an impulse of direct current is at the same time sent through the deflecting coils, *D D*, which through the building-up phenomenon of a current in a conductor deflects the spot along the *x* axis proportional to the time. The resultant wave obtained from these two simultaneous deflections is shown in Fig. 3.

The separate oscillations were scarcely visible on account of the enormous frequency (300,000 cycles per second), but the logarithmic envelope of the oscillatory waves was plainly produced upon the screen.

Besides the graph of the main oscillatory discharge, shown in the center of the screen, others appeared scattered along the entire *x* axis. These were undoubtedly due to unavoidable sparking at the brushes of the commutator, *C*.

Calculation of Auxiliary Pole Windings.

By Arthur Keller.

AUXILIARY or commutating poles perform two functions: They compensate the armature reaction in the neutral zone; this requires a number of ampere-turns per pole equal to the ampere-turns of the armature per pole. They produce a field under the face of the auxiliary pole of such magnitude that the e.m.f. induced thereby in the short-circuited coil will just balance the e.m.f. of self-induction produced by the change of flux around the short-circuited coil. To produce this commutating field an additional number of ampere-turns must be placed upon the auxiliary poles, and it is the purpose in this article to indicate the calculation of these ampere-turns.

If the e.m.f. of self-induction and the e.m.f. produced by the commutating field are equal in magnitude and opposite in direction, no local short-circuit current will flow in the coil under commutation. If, however, the two e.m.f's are not of the same magnitude, their difference will set up a local short-circuit current, the intensity of which depends upon the contact resistance of the carbon and the resistance of the short-circuited coil itself and its leads to the commutator. As shown in Fig. 1 this short-circuit current will increase the current density under the brush at one side, and if this density exceeds a certain value, sparking will ensue. The e.m.f. induced in the short-circuited coil by the commutating field must, therefore, approximate the same magnitude as the e.m.f. of self-induction, as an unbalanced e.m.f. of 3 volts will generally suffice to set up a short-circuit current large enough to produce sparking. The problem consists in calculating by means of the magnetic conductivities the flux set up around the short-circuited coil, and thence to determine the e.m.f. produced by the reversal of this flux at the time of commutation. The density of flux necessary under the auxiliary pole to induce an e.m.f. of same magnitude can then be determined. The magnetic conductivities per centimeter length of armature core can be calculated by the following formulas, in which.

l = length of armature core in cm.
l_p = length of auxiliary pole in cm.
D = diameter of armature in cm.
b = number of commutator bars.
T = number of turns per coil.
L = coefficient of self-induction of short-circuited coil.
v = peripheral speed of armature in cm. per second.
$2p$ = number of poles.
$2a$ = number of armature circuits.
I = total armature current.
B = induction per cm.^{2} under auxiliary pole.

All the dimensions are specified in the metric system except in Figs. 3 to 6, where the dimensions are given in inches for convenience to the designing engineer who employs the English system in his every-day work. The conductivities are ratios, not dimensions; it therefore does not matter whether the dimensions be introduced in inches or cm.

Conductivity λ_s of armature slot: For the upper coil in the slot (Fig. 2) we have:

$$\lambda_{s1} = \frac{4\pi}{10}\left(\frac{f_1}{r} + \frac{g}{3r}\right);$$

for the lower coil:

$$\lambda_{s2} = \frac{4\pi}{10}\left(\frac{f_2}{r} + \frac{g}{3r}\right);$$

the average of the two is:

$$\lambda_s = \frac{4\pi}{10}\left(\frac{f_1 + f_2}{2r} + \frac{g}{3r}\right).$$

The curves in Fig. 3 give values of λ_s for different depths, t, of slot in function of slot width, r, definite values for insulation having been assumed.

Conductivity, λ_t. This considers the flux which flows around the slot containing the short-circuited coil, finding its path through the teeth, armature core and air. The following formula is based upon the assumption that the flux flows in arcs of a

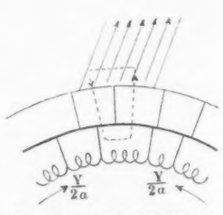


FIG. 1.—SHORT-CIRCUIT CURRENT.

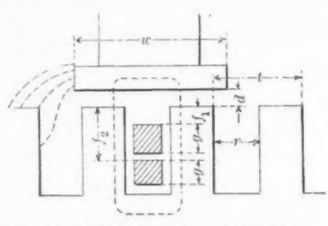


FIG. 2.—ARRANGEMENT OF SLOTS.

circle from the teeth at the left of the slot to the teeth at the right and that this flux extends over a complete pole pitch.

$$\lambda_t = 0.92\ log_{10}\left(\frac{\pi^2 D}{2r\ (p+1)}\right) \quad *$$

The curves of Fig. 4 show values for λ_t for different values of $\frac{D}{p+1}$ in function of slot width, r.

Conductivity, λ_p. The presence of the iron of the auxiliary pole increases the conductivity just calculated considerably. This increase may be figured as follows: In Fig. 2 the area of the flux which flows around the slot from one tooth through the air-gap and the pole face, back through the air-gap and the next tooth, is $\frac{w_1}{2K}$ for unity length of core, and the length of the path is $2d$. The reluctance of the iron path may be neglected. K is a coefficient which takes into account the diminution of the area under the pole through the armature slots. K is unity for a smooth core armature, more than unity for a toothed armature, and increases with an increase in slot width and a decrease of air-gap, as shown by curves, Fig. 6. The effective width of the auxiliary pole is larger than w on account of the leakage from the pole sides to the armature. It may be assumed to be

$$w_1 = w + 5d.$$

The conductivity of this path is, therefore,

$$\lambda_p' = \frac{4\pi}{10}\,\frac{w + 5d}{4dK}.$$

* Arnold: Die Gleichstrommaschine, Vol. I.

The above value of λ_p' is a maximum and is reached only at the moment the short-circuited coil is under the center of the auxiliary pole. At the beginning and at the end of commutation when the coil lies outside the sphere of influence of the auxiliary pole, λ_p' becomes zero. We may assume that λ_p' varies according to a sine curve, the average value being

$$\lambda_p = \frac{2}{\pi}\,\frac{4\pi}{10}\,\frac{w+5d}{4dK} = \frac{w+5d}{5dK}.$$

The curves in Fig. 5 give the values of λ_p for different air-gaps, d, in function of the pole width, w, the coefficient, K, being assumed as unity. The curves (Figs. 5 and 6) should be used in the following way: From Fig. 5 find $\lambda_{p_1} = \dfrac{w+5d}{5d}$, and from Fig. 6 find the value of K; then

$$\lambda_p = \frac{\lambda_{p_1}}{K}.$$

The conductivity, λ_e, of path around end connections of armature winding is practically a constant value for all machines and may be assumed to be

$$\lambda_e = 0.8$$

per cm. length of armature core.

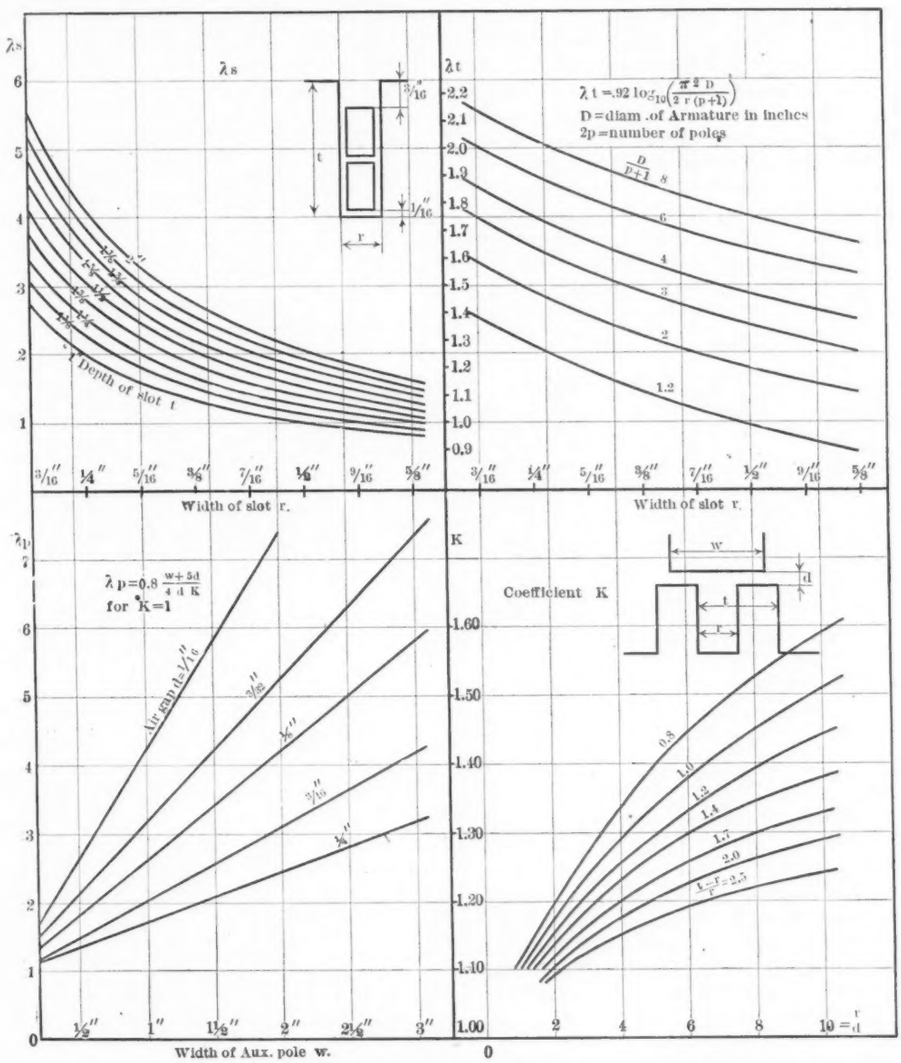
The coefficient of self-induction for the coil under commutation can now be calculated:

$$L = 2T^2 \Sigma\,(\lambda l),$$

or, if the auxiliary pole is of the same length as the armature core,

$$L = 2T^2 l \Sigma\,(\lambda). \qquad (1)$$

The frequency of commutation being $\dfrac{bn}{120}$, the reactance voltage of the short-circuited coil is



FIGS .3, 4, 5 AND 6.—DATA CURVES FOR AUXILIARY POLE WINDINGS.

$$e = \frac{I}{2a} \times 2\pi\,\frac{bn}{120}\,L\,10^{-8}. \qquad (2)$$

The above formula holds for a multiple-wound armature; in a two-circuit winding there are p coils in series and the reactance voltage must be multiplied by p.

This reactance voltage must be balanced by an e.m.f. induced in the short-circuited coil by the commutating field. This e.m.f. is

$e = B\,l\,v \times 2T\,10^{-8}$ for a multiple-wound armature, and

$e = B\,l\,v \times 2T\,p\,10^{-8}$ for a two-circuit winding.

By combining these formulas with formula (2), we obtain

$$B\,l\,v\,2T = \frac{I}{2a} \times 2\pi\,\frac{bn}{120}\,L.$$

If $$v = \frac{\pi D n}{60}$$

is introduced, we have for the induction under the face of the auxiliary pole,

$$B = \frac{I}{2a} \times \frac{b L}{l\ D\ 2T},$$

or $$B = \frac{I}{2a} \times \frac{b T}{D} (\lambda_s + \lambda_t + \lambda_p + \lambda_e). \qquad (3)$$

This formula holds for both two-circuit and multiple-wound armatures.

The m.m.f. required to produce this induction, B, in the air-gap, d, is:

$$Amp.\text{-}turns = \frac{10}{4\pi} K\ B\ d$$

for the air-gap. Assuming the m.m.f. required to drive the flux through the iron part of the path to be 25 per cent of the amp.-turns for the air-gap, the total number of amp.-turns needed on each auxiliary pole to produce the required commutating field is

$$A\,t = K\ B\ d, \qquad (4)$$

where d is the air-gap in cm. and K is a coefficient which takes into account the increase in reluctance of the magnetic path due to the presence of the armature slots (see Fig. 6).

The preceding formulæ have been developed for the case in which the length of the auxiliary pole equals that of the armature core. If, however, the auxiliary pole is shorter than the armature, the commutating field will induce an e.m.f. only in that part of the conductor which lies under the auxiliary pole. Furthermore, the armature field will build up freely outside the region of the auxiliary poles and by the rotation in this field an e.m.f. will be induced in those parts of the short-circuited conductors which are outside of the influence of the auxiliary poles, and are exposed to the field produced by the armature amp.-turns. This e.m.f. has the same direction as the e.m.f. of self-induction and must be compensated in the same way as the reactance voltage. A further addition of amp.-turns is, therefore, necessary on the auxiliary poles, which may be determined as follows:

The m.m.f. of the armature per pole is

$$\frac{I}{2a} \times \frac{b T}{2p}.$$

If $2C$ is the distance between the tips of two adjacent main poles, the field set up by the armature amp.-turns in the neutral zone is

$$B_o = \frac{4\pi}{10} \frac{I}{2a} \frac{b T}{2p} \frac{1}{C},$$

and the e.m.f. induced in the short-circuited coil by the rotation in this field will be:

$e_o = B_o\ (l - l_p)\ v\ 2T\ 10^{-8}$ for a multiple-wound armature, and $e_o = B_o\ (l - l_p)\ v\ 2T_p\ 10^{-8}$ for a two-circuit armature.

If B_1 is the additional induction under the auxiliary pole necessary to induce in the short-circuited conductors of length l_p an e.m.f. equal in magnitude to e_o and opposite in direction, we have $e_o = B_1\ l_p\ v\ 2T\ 10^{-8}$ for a multiple-wound armature.

$$B_1\ l_p\ v\ 2T = B_o\ (l - l_p)\ v\ 2T,$$

$$B_1 = B_o \frac{l - l_p}{l_p},$$

$$B_1 = \frac{l - l_p}{l_p} \times \frac{4\pi}{10} \frac{b T}{2p} \frac{I}{2a} \frac{1}{C}.$$

The following example will make clear the use of these formulas. To design auxiliary poles and windings for a motor of 7.5 hp, 600 volts, 12.5 amp., 4 poles and 550-1,650 revolutions:

Armature diameter = 10½ inches = 26.7 cm.
Armature length = 4¼ inches = 10.8 cm.
Number of armature slots = 61.
Dimensions of slot = 17/64 inch × 1 inch.
Number of turns per coil = 7.
Number of commutator bars = 183.
Half-distance between main pole tips, C, = 4.0 cm.
Peripheral speed of armature, v, = 2,300 cm.-sec., at 1,650 rev.
Armature winding is two-circuit.
Diameter of commutator = 8 in.
Thickness of carbon = ⅜ inch.

Slot pitch, t, $= \frac{\pi\ 10\frac{1}{2}}{61} = .545$ in.

Clearance under auxiliary pole, d, = 1/16 in. = .158 cm.

Assume the length of the auxiliary pole to be equal to the length of the armature core. The width, w, of the auxiliary pole face may be assumed to be one slot pitch plus the thickness of the carbon reduced to the diameter of the armature:

$$w = .545 + .375 \frac{10\frac{1}{2}}{8} = \text{approx. 1 in.}$$

The conductivities can now be found from the curves Figs. 3 to 6; they are:

$\lambda_e = 1.9$ (Fig. 3)

$\frac{D}{p+1} = \frac{10.5}{2+1} = 3.5$ . . . . . $\lambda_t = 1.7$ (Fig. 4)

$\frac{t-r}{r} = 1.05$; $\frac{r}{d} = 4.25$; $K = 1.29$

$\lambda_{p_1} = 4.2$; $\lambda_p = \frac{\lambda_{p_1}}{K} = \frac{4.2}{1.29}$ . . . $\lambda_p = 3.3$ (Figs. 5 and 6).

$\lambda_e = 0.8$

$\Sigma\ (\lambda) = 7.7$

$L = 2\,T^2\,l\,\Sigma\ (\lambda) = 2 \times 7^2 \times 10.8 \times 7.7 = 8{,}150$

$$e = \frac{I}{2a} \times 2\pi \frac{b\,n}{120} L_p\ 10^{-8} = \frac{12.5}{2} \times 2\pi \frac{183 \times 1{,}650}{120} \times 8{,}150 \times 10^{-8} \times 2$$

$e = 16$ *volts.*

$$B = \frac{I}{2a} \frac{b T}{D} \Sigma\ (\lambda) = \frac{12.5}{2} \times \frac{183 \times 7}{26.7} \times 7.7 = 2{,}300 \text{ lines per cm.}^2$$

The amp.-turns necessary to produce this induction are:

$$K\,B\,d = 1.29 \times 2{,}300 \times .158 = 470.$$

The amp.-turns necessary to compensate the armature reaction are:

$$\frac{I}{2a} \times \frac{b T}{2p} = \frac{12.5}{2} \times \frac{183 \times 7}{4} = 2{,}000\ a\text{-}t.$$

Total amp.-turns necessary on each auxiliary pole = 2,470; i. e., the ratio between auxiliary amp.-turns and armature amp.-turns is:

$$\frac{2{,}470}{2{,}000} = 1.235.$$

It is interesting to notice how the design changes if the auxiliary pole is shortened in length. The following table gives the results for a length of auxiliary pole equal to .8, .6 and .4, respectively, of the armature length.

The induction under the auxiliary pole and consequently the necessary amp.-turns increase with a decrease in length. The table shows clearly that a short pole is more advantageous than a long one for the following reasons:

1. The total e.m.f. to be balanced by the commutating field

is smaller with the shorter pole. The machine is, therefore, less sensitive, and the liability of error in calculating the amount of compensation is reduced.

$\frac{l_p}{l} = \frac{\text{length of aux. pole}}{\text{length of arm. core}}$	0.8	0.6	0.4
l_p	8.6	6.5	4.3
$\Sigma(\lambda_s+\lambda_t+\lambda_c) = 10.8(1.9+1.7+0.8)$	47.5	47.5	47.5
$l_p \Sigma\lambda_p = l_p \times 3.3$	28.4	21.5	14.2
$\Sigma(\lambda l)$ = ...	75.9	69.0	61.7
$L = 2T^2\Sigma(\lambda l) = 2\times 7^2\times\Sigma(\lambda l)$	7400	6750	6050
$e = \frac{I}{2a} \times 2\pi \frac{n\,b}{120} L\,10^{-8} \times p$ .....Volts	14.6	13.3	12.0
$B_0 = \frac{4\pi}{10}\frac{I}{2a}\frac{bT}{2p}\frac{1}{C} = \frac{4\pi}{10}\times 2000 \times \frac{1}{4.0} =$	625	625	625
$e_0 = B_0 (l - l_p)\, v\, 2Tp\, 10^{-8}$ .....Volts	0.9	1.8	2.7
$e_0 + e_a$ .....Volts	15.5	15.1	14.7
$B = \frac{(l+l_0)\,10+8}{l_p\, v\, 2Tp}$ .....lines per cm.^{2}	2800	3600	5300
At to produce commutating field $= KBd =$	570	730	1080
At to compensate arm. reaction $= \frac{I}{2a} \times \frac{bT}{2p} =$....	2000	2000	2000
At per auxiliary pole	2570	2730	3080
$\frac{\text{auxiliary amp.-turns}}{\text{armature amp.-turns}} = \frac{l_p}{l}$	1.285	1.365	1.54
Total flux per aux. pole$=Bl_p(w+5d)$ lines.	82500	79000	77500	76000
Relative amounts of copper on aux. pole..	100	91	83	76

2. The ventilation of the armature is less obstructed by the short pole.

3. The amount of copper and the I^2R loss are somewhat smaller and the efficiency of the machine is correspondingly higher. The values for the relative amounts of auxiliary copper given in the last line of the table have been obtained by assuming the same density in the auxiliary pole in all cases, i. e., 10,000 lines per cm.^{2}. The section of the pole was assumed a rectangle of length, l_p, and such thickness so as to give the above-mentioned induction in the pole. The thickness of the auxiliary coil was assumed as 3 cm., the size of wire being the same in all cases.

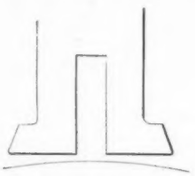


FIG. 7.—SLOTTED AUXILIARY POLE.

If the commutation is to be satisfactory at all loads and particularly at overloads, care should be taken that the path of the commutating flux is not saturated at any point, as otherwise the density under the pole face will not increase proportionately with the armature current; also, if the e.m.f. of self-induction and the e.m.f. induced by the commutating field balance each other at full load, they will not balance each other at overloads if the path of the commutating field is saturated. Particularly a short pole should be made thick enough to insure a low induction in the pole.

The formulæ show clearly that an increase in air-gap means an increase in amp.-turns on the auxiliary pole; in order to save in copper it is, therefore, of advantage to reduce the clearance under the auxiliary pole to the mechanical minimum. But it must be remembered that a larger clearance means better commutation, because λ_p decreases. In such cases where commutating conditions are very severe, it will be advisable to use a larger clearance, although this requires somewhat more amp.-turns. A cheaper way to decrease λ_p is to make a slot in the auxiliary pole as shown in Fig. 7. Suppose the auxiliary pole in the first example to have a slot about 3/16 in. to ¼ in. wide; this would reduce λ_p to about half its former value and $\Sigma(\lambda) = 6.05$ instead of 7.7. This means a reduction of 21.5 per cent in the reactance voltage and 4 per cent less auxiliary copper.

	Without slot in pole.	With slot in pole.
Reactance voltage	16	12
At to produce commutating field.....	470	370
At to compensate arm. reaction.....	2,000	2,000
At on aux. pole.....	2,470	2,370
Ratio of ampere-turns.....	1.235	1.185

By making a suitable slot in the auxiliary pole the reactance voltage may be decreased to the same amount as if the air-gap under the auxiliary pole had been doubled, but while an increase in air-gap means an increase in auxiliary pole copper, a slot in the auxiliary pole will accomplish the same result without requiring any additional copper.

The above method of determining the amp.-turns for the auxiliary poles may seem complicated to the designing engineer, but as it is not necessary to determine all the values calculated in the above example, the method may be shortened considerably. It will generally be sufficient to calculate the induction under the auxiliary pole face and the number of amp.-turns required per pole. The above method may be condensed into the following simple formulæ:

First, the conductivities are determined from Figs. 3 to 6; then the induction under the auxiliary pole is calculated from the formulæ:

$$B = \frac{I}{2a} \times \frac{b\,T}{D} \times \Sigma\,(\lambda),$$

if the auxiliary pole is of same length as the armature core; and

$$B = \frac{I}{2a}\,\frac{b\,T}{l_p}\left[\frac{\Sigma(\lambda l)}{D} + (l - l_p)\,\frac{1.25}{2p\,C}\right]$$

if the auxiliary pole is shorter than the armature. These formulæ are correct for both two-circuit and multiple-wound armatures. After B has been calculated the formula $At = KBd$ determines the amp.-turns necessary to produce this induction.

Hydro-Electric Power Organization and Operation.

At the regular meeting of the Boston Branch of the American Institute of Electrical Engineers held on February 20, Mr. Farley Osgood, general manager and chief engineer of the New Milford (Conn.) Power Company, presented a paper upon the "Organization and Operation of Hydro-Electric Power Plants." The paper was based entirely upon conclusions drawn from actual operating experience. It was pointed out that the hydraulic and electric power problem must be viewed both from the physical side, including hydraulic development, the power station and the line, and from the personal side, dealing with the organization and esprit de corps of the operating force. Tendencies in design were then discussed and the lecture closed with a résumé in lantern slides of various operating experiences with particular reference to the writer's own system.

In considering the hydraulic development, the amount of water available was shown to be the first important matter to determine. In comparatively few instances is but a portion of the water obtainable; most plants utilize the entire available flow of the stream. The records of the U. S. Geological Survey contain a vast amount of valuable information upon the flow of different streams and water sheds, but the existence of this data has at times been entirely overlooked by engineers. The limitations of each particular development must be carefully taken into account. Over-enthusiasm is unwise in power projects. The records of the flow of streams for many years back should be studied if available, and the history of floods and high water times should be gathered from old inhabitants and other sources. The maximum and minimum discharge

should be known for a long period of years, and as far as the data allow, curves of daily discharges should be plotted. The mean discharge is the proper basis upon which to figure.

Mr. Osgood discussed the essential features of dam construction briefly, pointing out the importance of being able to divert the water so that in case of necessity the head works can be cut out of service. Whether the dam be built of concrete, rock-filled or hollow, it should invariably be strong enough to resist the fuse of floods and ice jams. The destructive effect of ice jams is often far greater than one would realize in advance. In cases where the dam can be used as one side of the power house the cost of construction will generally be lower. When a canal is necessary the open type is least expensive. In the Northwest wooden tubular canals have found much favor, but in the eastern sections of the country iron or steel pipe has been generally adopted. A waste gate arrangement at the head of every canal is of great importance, and when possible there should be a gate opening from the top downward, to take care of ice and other floating objects, and a gate opening from the bottom upward, to take care of the main body of the water.

If a forebay can be included in the hydraulic scheme it will result in a great steadying of the flow of water, and at times of sudden demand from the generators the annoyance of not being able to feed water to the wheels fast enough will be avoided. Ponds en route between the head works and forebay also aid in steadying the flow. At the head works metal gates are stronger and more easily operated than wooden gates. An ample spillway is desirable at the forebay. Tubular canals need anchorage at frequent intervals, although the weight of water in the pipes reduces the liability of slippage on account of the increase in friction between the tubular canal and the earth. Trash rocks should be provided in open canals, but they should not be over 4 ft. wide and 2 ft. is better. The installation of a vertical triplex hoist with runway above the rocks greatly facilitates the work of maintenance.

In all hydro-electric plants water relief devices are essential, either in the form of relief valves or by the standpipe method. When the standpipe is used care must be taken to carry it to the level of the main reservoir and to provide for the discharge of water below the plant in case it backs up in the pipe suddenly. Usually the best way of accomplishing this is to install a discharge pipe connecting the standpipe overflow with the tail race. The standpipe must be kept from freezing, and in general it should be equipped with a branch of whatever heating system warms the power house.

The power station layout depends largely upon the field of work to be supplied by the plant. The load requirements largely determine the number and character of the units. For general transmission work a frequency of 40 or 60 cycles is probably the most acceptable, though for railway service 25 cycles is much to be desired, and in recent discussions even 10 or 15 cycles have been strongly advocated. Alternating current is the accepted standard for long-distance transmission and the three-phase system is now thoroughly established as the proper arrangement for high-tension transmission. The desirable voltage to use depends upon the length of the line chiefly. If transformers are not desired in the generating plant and the distance is moderate, a generator voltage of 11,000 is perfectly good practice, but if the distance warrants a higher voltage it is well to select a potential between 24,000 and 60,000 volts, depending on the line losses, load and distance.

The head available determines the speed of the water wheels and this in turn determines the design of the generators. A most vital point in the design of hydro-electric plants is that generators and water wheels must be considered together. With high heads the provision of wheels must be along impulse lines, regulation being either by deflection of the stream or by nozzle deflection. The use of electric motors on the wheel gates is good practice, for it enables the supply of water to be very quickly cut off in times of emergency. A second gate with a by-pass is desirable in high head plants to facilitate inspection and repairs.

The determination of the number and size of generating units to install depends largely upon local circumstances, but in general it is well to have at least one unit in the station of a capacity equal to the minimum kilowatt output of the plant at low water, at least in stations of moderate power. The importance of having plenty of room between the various machines of a hydro-electric plant can scarcely be exaggerated. Land is almost always cheap at the sites of such plants, and the usual considerations of forced compactness do not apply. Many a station is ruined by the machines being crowded together.

Exciters can be driven in various ways, but there should always be at least one water-driven exciter and preferably another as a spare unit. In general one exciter should have capacity enough to supply all the station. Individually driven exciters are the best type. When an exciter is driven by belt or by being mounted on the shaft of a large unit water is wasted unless the main machine is well loaded; and when an exciter is rigidly attached to the generator shaft, if the speed of the larger unit falls off temporarily because of increased load, there is a tendency for the exciter voltage to sag also at the very time when constant or additional excitation is most needed. The exciters should all be visible from the switchboard, and in case the latter is located on a gallery and one exciter is motor-driven, it is a good plan to install the latter on the gallery also. The motor-driven exciter is an economical operating unit, but there always must be at least one water-driven outfit to enable the station to be started. Water wheel governors should be placed near the wheels and controlled electrically from the switchboard. The location of the switchboard on a gallery enables the entire operating scheme of the station to be taken in at a glance; the bus-bars can be well disposed of and isolated if necessary beneath the gallery floor.

Both oil and knife switches should be included between the generator and the bus-bars. Protection thus afforded is well worth while. In some plants metal curtains are used to cover up oil switches in compartments, but the use of glass fronts is more desirable, for the glass enables the attendant to see the exact condition of the switch at all times. Generator field rheostats may be installed at the back of the gallery, but they should in any case be set up so that the heat from them will not warm up the gallery floor. Sometimes the mistake is made of locating the switchboard too near the front of the gallery, in which case there is often a chance of trouble caused by an attendant stepping back suddenly from the railing and inadvertently closing or opening some switch with his clothing. The high-tension room need not be in a separate building, but it is well to provide for its isolation from the rest of the plant. Automatic line opening devices are essential.

Space is of supreme importance in the high-tension room. Lightning arresters should be located in plain sight of the attendants, so that their behavior can be seen at all times. Water-cooled, oil-insulated transformers have a higher insulation breakdown point than air-blast transformers, and are also to a certain extent self-recovering. Single-phase transformers are more costly than three-phase units, but they are more convenient in case of a burn-out, as two single-phase units can be reconnected and the equipment kept in service, whereas one is "down and out" if a three-phase transformer goes to the bad. A track flush with the floor is a good feature in a transformer room, so that transformers can be moved out when necessary, either by jacking up and by trucking them out or by fitting the original units with wheels. Hoisting apparatus is dangerous in a high-tension room. The problem of transformer flexibility is really solved best by installing a spare bank. Where there are many transformers the use of sectionalized bus-bars gives the simplest arrangement. Two arrester equipments are very valuable. Slate should never be used in the hoods through which high-tension wires enter or leave a building; open holes are better, but glass-fitted holes best of all.

Generally speaking, the metal pole line is the most desirable for the transmission service. Maintenance and depreciation are much lower than on wooden pole lines; fewer towers than poles are required, and the number of insulators is reduced by

the longer spans possible. The cost of each tower depends a good deal upon its design. If simple towers are used the cost of each may run as low as $70, but as one employs angle-iron towers of special design, with heavy concrete foundations, the cost may run from $175 or $250 upward. It is really a benefit that the steel tower pole line grounds the system in time of trouble. As for conductors, aluminum can be put in place more easily than copper, but the latter can be purchased for quicker delivery. The cost of each for the same conductivity is not showing much discrepancy at the present time. Reinforced concrete poles are being tried on some transmission lines, but their usefulness has not yet been determined. Porcelain insulators are stronger and stand temperature changes better than glass. The insulation of telephone lines carried on transmission poles is very important, as is the insulation from the ground of the employe using such lines. Transpositions should be made at least every three poles. When a transmission line grounds, the ringing of the telephone bells often serves as an excellent alarm as to the state of affairs.

Fewer attendants are required in hydro-electric stations than in steam plants, but in view of the remote location of the former and the larger individual responsibility, proportionally speaking, they should be clever mechanics. Good wages should be the rule. Seldom are more than three men required on a shift. Canals need constant inspection; in the winter season a run of slush ice will cause greater anxiety than a lightning storm. The intake gates usually have to be attended to for the purpose of meeting the load requirements. The line department should have men capable of building, repairing and operating the line. Harmony and good fellowship is very important.

Automatic devices are admirable as long as everything works well, but they are not so good when abnormal conditions come. Each man in the plant should be responsible for some special division of the work. In this way when trouble comes the chief engineer's hands will be upheld, and the situation can be most readily cleared up. Water wheels should be inspected at regular intervals. Broken vanes, cracked governor rods, deflective buckets and other troubles need to be watched for constantly. A little extra precaution in the way of inspection will save enormous delay sometimes, for light repairs can be made readily if taken in season. When the bucket gate openings are stopped up by slush ice, the only remedy is to shut down and open the wheel case to thaw the machine out. Fish, eels and other foreign bodies frequently are ground up in water wheels, but although these conditions make inspection unpleasant, it is none the less necessary. When sticks get into the wheel cases it often happens that the stick which makes the largest amount of noise is really the least dangerous, for it is generally too large to pass through the openings between blades and buckets. Rip-rap construction and sealing of canal banks are very important, for seepage should be reduced to the lowest quantity.

Some Newly Observed Forces Within an Electric Conductor.

In a paper read at Columbia University before the American Physical Society on March 2, 1907, Dr. E. F. Northrup stated that Mr. Carl Hering, in working with relatively large alternating currents, had observed last summer a surprising phenomenon. In passing such a current through a liquid conductor he noted that at one point of the conductor there was formed a depression like the letter V, which in one case extended as much as six inches below the level of the liquid. He communicated this observation to Dr. Northrup, who perceived that the phenomenon required explanation and probably had a theoretical and practical interest. Dr. Northrup devised several laboratory experiments to confirm the observations made by Mr. Hering. He also developed physical conceptions and a mathematical theory of the phenomenon, which were amply confirmed by other experiments and apparatus which he devised and tried. The following is a brief summary of the experiments made and the conclusions reached.

Eight hundred amperes were passed through a channel of mercury which diminished from a large cross-section where the electrodes entered to a very small cross-section at its middle point. The passage of the current caused the mercury in the narrow portion of the channel to depress even to the bottom of the channel and so rupture the circuit. The same effect was shown in a more striking manner by using a liquid alloy of potassium and sodium. The channel was made ten inches deep by one-quarter inch wide. The alloy was covered with oil. A current of 180 amperes caused the alloy to depress in the form of a V to the bottom of the channel. The physical explanation of this phenomenon Dr. Northrup gave as follows:

"When a conductor carries an electric current, we may picture with Faraday, a medium filled with lines of magnetic induction and consider all the forces connected therewith, or we may consider with Ampere the conductor only, or the imaginary filaments of which it is composed as giving rise to forces which act through space according to laws ascertained by experiment. Either view will lead to a correct explanation of the phenomenon in question. By Faraday's view there is a field of magnetic force exterior to any conductor. The lines of force are circles about a circular conductor, and the intensity of the field at any point outside the conductor is equal to twice the current divided by the distance from the axis of the conductor to the point in question. There is, however, also a field of magnetic force in the interior of the conductor, which field is zero at the center of the conductor and a maximum at its circumference, increasing proportionally to the distance measured from the axis. The existence of this field was demonstrated by a simple experiment. A long glass tube three inches in diameter was filled with copper sulphate solution. A current of five amperes was led in at the top and out from the bottom of the tube, the electrodes being copper disks. On a thread along the axis of the tube two small magnets were hung so as to be able to revolve in a horizontal plane about the thread as an axis. The north poles of the two magnets were near the circumference of the tube and the south poles near the axis. Since the north poles lay in a strong magnetic field and the south poles in a weak field, the two magnets revolved in a horizontal plane while the current was blowing. A clock-wise rotation corresponded to a passage of the current from the top to the bottom of the tube.

The action of this interior field on a current filament was then demonstrated as follows: A very fine high resistance wire was attached to the upper and lower copper disks near opposite points of their circumference. The wire was somewhat longer than the distance from the top to the bottom copper disk and hung loose between them. When current was sent through the liquid column some current would also pass through the wire. This wire, carrying current, finds itself in a field of magnetic force with circularly disposed lines; hence the wire is acted upon by a force tending to move it across these lines. The direction of the force is shown to be such as to so move the wire that it becomes coincident with the axis of the liquid column. Experiment confirmed these anticipations. It is now seen that if one replace in imagination the wire by a filament of the liquid column itself this filament will tend to move toward the axis and so with all the imaginary filaments of which the conductor is composed. Hence it can be understood that if the liquid conductor lies in a channel and has a free surface it will tend to contract in sections where the suction is least. Since all the filaments are acted upon by a force which acts radially toward the axis of the conductor, it follows that the axis of a liquid conductor carrying current is under a greater hydrostatic pressure than its circumference.

By Ampere's view each imaginary filament of the conductor attracts every other filament giving a resulting attraction on all the filaments which acts radially toward the axis. The forces of attraction are in all respects analogous to the attractive forces of gravity which would exist in an infinitely long cylinder of circular cross-section like the conductor. An experiment was

made which strikingly illustrated the existence of the interior pressure in a conductor. A fibre tube of about ½ in. cross-section was provided. A few small holes were bored through it at its middle. This tube was fitted in another tube of about twice the diameter. The space at one end between the inside and outside tubes was closed. The tubes were set in a vertical position. The top and bottom of the smaller tube were fitted with brass plugs. A hole was drilled through the center of the top plug. The inside and the outside tubes were filled with mercury. Current was passed lengthwise through the mercury in the inside tube. The high pressure produced at the axis of the inside tube caused the mercury to be forced up through the hole in the top brass plug at the same time being drawn in at the holes in the middle of the small tube from the space between the tubes. The mercury forced through the top hole overflowed into the well between the two tubes and thus there was maintained, as long as the current was left on, a continuous flow or circulation of mercury.

The experiment was modified and the effects produced enhanced by a special disposition of iron in the inside tube.

The most useful results obtained from a practical standpoint are the methods and apparatus which Dr. Northrup has devised for vastly increasing the final pressure obtained. This is accomplished by adding in series the high pressure at the axis in one portion of the conductor to the low pressure at the circumference in another portion of the conductor and repeating this process any desired number of times. He thus showed that a conductor of one-half inch diameter and which consists of 1,000 alternate strata of copper and mercury held in a suitable casing can, when carrying 600 amperes, yield a pressure that would sustain a column of mercury over 7 ft. high.

The forces described, since they depend only upon the square of the current and the linear dimensions, may be used as an accurate measure of the current, alternating or direct. A practical form of ammeter operative through the agency of the internal pressures in a conductor carrying current was shown in operation. As the forces can be enhanced by a proper disposition of iron in a heterogeneous circuit, motors without brushes or slip rings may be made operative, and, since the power is the product of current an delectromotive force, Dr. Northrup stated it is not impossible, even if large currents are required, that good efficiencies may be obtained.

Letters to the Editors.

Prevention of Sparking in Alternating-Current Commutator Motors.

To the Editors of Electrical World:

Sirs—There appears on page 306 of your last issue of the Electrical World (February 9, 1907) an article under the title "Prevention of Sparking in Alternating-Current Commutator Motors," which I cannot allow to pass unchallenged. In this article you call attention to four patents, issued on January 15 to Mr. Marius Latour, three of which relate to a plurality of parallel armature windings. The essence of the said three patents seems to be correctly stated by you in the following sentence: "The novel features reside in so arranging the coils of the separate windings as to obtain an even progression of the voltages in the several coils without increasing the number of slots."

Now, I wish to point out to all whom it may concern, that I claim to have discovered the correct method of arranging the coils of multiple drum windings as long as five or six years ago. The following facts will, I believe, fully prove my claim:

A U. S. patent No. 714,721 for an "Armature Winding for Electric Motors or Dynamos" was issued to me on December 2, 1902. Quoting from the specification of this patent some of the objects of the invention were: " . . . second, to devise means for equalizing the electromotive forces, and consequently the load between two sets of coils or windings which are connected together in parallel by means of the brushes, and, third, to so connect each set of coils (or each winding) to the commutator that a correct position of the brushes for one set of coils (or winding) becomes equally correct for the other set of coils."

These objects were fully realized by my invention, and the theory of properly arranging the coils of several parallel drum windings was fully disclosed in both the drawings in the text.

Not only did I provide for "an even progression of the voltages in the several coils" (see the third object of my invention), but I also provided for equalizing the total voltages of the several windings so that each independent winding would carry its proper portion of the load. (See the second object of my invention.) The latter is particularly important in connection with modern large slots and teeth.

The two above-mentioned objects were accomplished substantially in the manner indicated by claim 5 of my patent, which reads as follows: "An armature of the slotted drum type provided with two windings or sets of coils independently connected to a single commutator, one of said windings having its coils wound in slots, the angle between which is slightly greater than the polar pitch angle, and the coils of the other winding having its coils wound in slots the angle between which is slightly smaller than the said polar pitch angle."

In addition to the above I wish to state that many machines have been built with multiple drum windings correctly arranged according to my specifications. Looking over some old winding and test data, I find that I have furnished specifications for such windings to the following firms: The Sprague Electric Co., of New York; the Johnson-Lundell Electric Traction Co., Ltd., Southall, England, and J. H. Holmes & Co., Newcastle-on-Tyne, England. Said winding specifications were either for double series windings or for double parallel windings, having two, four or six coils per slot.

With exception of some special motors built by the Johnson-Lundell Co. the two windings were always placed at equal distance from the periphery of the armature core, this being the most conventional way of arranging the two independent windings. All of said windings had coil widths differing from each other by the distance between adjacent slots, as per the following two winding specifications, which have been selected at random from numerous similar specifications:

A.—"60-kw, direct-current generator, 100 volts, 600 r.p.m., 6 poles. Armature core = 19.5 x 7 in., 55 slots .36 x 1.8-in, two series windings, 1 turn per coil. Copper strip for each winding = .115 x .625 in. Two coils per slot. One winding has coils placed in slots No. 1 and No. 10, etc., the other winding has coils placed in slots No. 1 and No. 11, etc. Commutator has 110 bars, connected 1—37—73—109, etc., for one winding and 2—38—74—110, etc., for the other winding." This specification was furnished by me to the Sprague Electric Co. November 22, 1901, and an armature was completed January 17, 1902. The above machine has been in operation since the early part of 1902 at the factory of the Fahys Watchcase Co., Sag Harbor, L. I.

B.—"300-kw, direct-current generator, 250 volts, 475 r.p.m., 6 poles. Armature core = 36x10.75-in., 62 slots = 19/32x2.18-in. Two parallel windings, 1 turn per coil. Copper strip for each winding = .057x13/16-in. Six coils per slot. One winding has its coils placed in slots No. 1 and No. 11, etc.; the other winding has its coils placed in slots No. 1 and No. 12, etc. Commutator has 372 bars, connected 2—4—6, etc., and 1—3—5, etc."

This machine was also built by the Sprague Electric Co., from a specification furnished October 23, 1901 and it was tested April 16, 1902. It has been in practically continuous service since the spring of 1902 in the power house of the American Locomotive Co., Paterson, N. J. (Cooke Works).

New York. Robt. Lundell.

Calculation of Dynamo Sparking Characteristics.

To the Editors of Electrical World:

SIRS:—Mr. Kennedy's contribution on the above subject in your number of February 16 is interesting, although it can scarcely be considered as providing a really general method of predetermining the sparking limit. For machines designed along present conventional lines, the complete formula will apply with a fair degree of uniformity, but not for radical departures or even highly special designs because it does not take into consideration the armature reaction upon the magnetic field. Let me hasten to add, however, that no one has yet succeeded in deriving a method which is absolutely general in its application and is also "wieldy" under modern conditions of practical designing.

Mr. Kennedy's statement: "if the dynamo is designed to carry its greatest load without moving the brushes from the geometrical neutral point, the reluctance of the air-gap may be made as small as desirable by other considerations, without regard to its effect upon the sparking point," is contradictory in its terms, for it is impossible to design a dynamo to work sparklessly with the brushes fixed at the geometrical neutral point without taking into consideration the air-gap length and the armature reaction, unless the proportion of armature circumference covered by the pole faces be impractically small.

The use of the symbol P_p in Mr. Kennedy's formula is unnecessary, and its omission would, of course, simplify the formula. Since $P_p = \frac{P}{m}$, for both multipath and two-path armature windings, there is no need to add it to the already long list of symbols, and the formula could be better written:

$$I = \frac{m^2 (10 \pm V_1)\ 10^8}{6.3\, cr\, P\, N_1^2 \left[\left(4 + \frac{1.6d}{w}\right) l_1 + l_2\right] + \frac{4.5 f\, l\, N^2 r}{S}}.$$

NEW YORK. CECIL P. POOLE.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers:

Alternators with Auxiliary Regulating Field.—HEYLAND.—An article referring to his new method of compensating and compounding alternators by means of a unipolar stray flux (see the author's article in ELECTRICAL WORLD, February 23, page 386). The author now shows with the aid of a fully worked-out example for a 350-kw alternator, how to determine the necessary alternations for any given alternator of ordinary design. The example chosen relates to the case in which, by suitable design, the unipolar flux is caused to weaken the exciter field throughout the whole range of regulation. The unipolar field is strongest at no load, but is gradually diminished by the armature reaction as the load on the alternator increases and vanishes altogether at full load. Consequently the exciter voltage increases from a minimum at no load to a maximum at full load. It is claimed for this arrangement that it utilizes the active material of the machine to the fullest extent, besides giving a perfect and reliable regulation at all loads and for all power factors, and, further, that it leads to a "stiffening" of the exciter field which, in consequence, is little affected by fluctuations in the driving speed. Finally a description is given of a simple means for adjusting the regulation curve on the finished machine.—Lond. *Elec.*, February 8, and *Elek. Zeit.*, February 7 and 14.

Testing Direct-Current Dynamos.—SOULAIROL.—An article on a method for determining the efficiency of a direct-current dynamo by running it successively as a generator and as a motor at the same speed, with the same excitation and with the same current in the armature. The formulas showing the possibilities of this method are given both for a separately-excited dynamo and for a shunt-wound machine.—*L'Eclairage Elec.*, February 9.

Lamps and Lighting.

Testing Incandescent Lamps.—WILD.—Criticisms of various points in the proposed British standard specification for carbon incandescent lamps, which was recently mentioned in the Digest. The first criticisms refer to tests of the insulation resistance of the lamp caps and to vacuum tests. Since the specific consumption is to be determined on the basis of tests of horizontal candle-power—instead of mean spherical candle-power, which is the only true measure of the total light emitted—it follows that filaments of different forms will be in reality differently rated. Five per cent of the lamps shall undergo life tests and will be run not at their marked voltage, but will be started at some standard watts per candle. This is an ideal condition if the object of the test is to ascertain the quality of the filament, quite apart from its rating. The advantage gained by running at standard consumption is, however, more than neutralized by the fact that the test is terminated, not when the candle-power has dropped to 80 per cent of its original value, but when the candle-power has dropped to 80 per cent of its standard value. Thus a lamp starting at 16 cp may drop to 80 per cent of this, whereas a lamp starting at 16.5 cp is allowed a much larger drop of candle-power, although both lamps are started at the same specific consumption. If a lamp starts at 1½ per cent above its standard candle-power, the useful life as specified is extended by about 10 per cent and likewise the lamp that starts 1½ per cent low in candle-power is robbed of 10 per cent of its life. Moreover, an error of 1½ per cent in the last candle-power measurement also makes a difference of 10 per cent plus or minus to the life of the lamp. Since 10 per cent variation of life is all that is permitted by the specification, it follows that the passing or rejecting of a large batch of lamps will depend quite as much upon the judgment of the testing authority in selecting the lamps to be tested, and the accuracy of the final measurements of candle-power, as upon the merits of the lamp filaments. The use of the mean horizontal instead of the mean spherical candle-power may involve a considerable error on account of the fact that the reduction factor varies in lamps of different manufacture from a value of 0.8 to 0.9. As a basis for a standard life test specification the following is suggested by the author: The lamps selected for life test should be run for, say, 500 hours, and to be tested for mean spherical candle-power at start, and after 100, 200, 300, 400 and 500 hours. These results are to be averaged together. The average candle-power of all lamps tested throughout the 500 hours not to be lower than a certain limit. The average watts and specific consumption should also fall below and above certain limits, respectively. Any lamp failing in vacuum during the run should be omitted from the tests. As the final values obtained are the averages of many separate measurements, the personal error in making the measurements is eliminated. Several methods of measuring the mean spherical candle-power are briefly outlined and a simple one is mentioned which consists in measuring the maximum horizontal candle-power. This method involves two measurements taken on opposite sides of the lamp. The value obtained should be multiplied by a factor which is practically independent of the shape of the filament. This factor varies only from 0.805 to 0.825 in lamps of all makes.—Lond. *Elec. Rev.*, February 15.

Testing Incandescent Lamps.—PATERSON.—The conclusion of his paper on light standards and the present condition of the

high-voltage incandescent lamp, the first parts of which have already been abstracted in the Digest. A series of tests has been carried out at the British National Physical Laboratory in order to determine if it is possible by an overrunning test to predict the percentage drop which lamps would have after a given time if run under ordinary conditions. No uniform rule could, however, be found for different types of lamps when they were overrun at 40 per cent above the normal voltage corresponding to a specific consumption of about 1.3 watts per candle. However, it is quite possible that a life test at 2.5

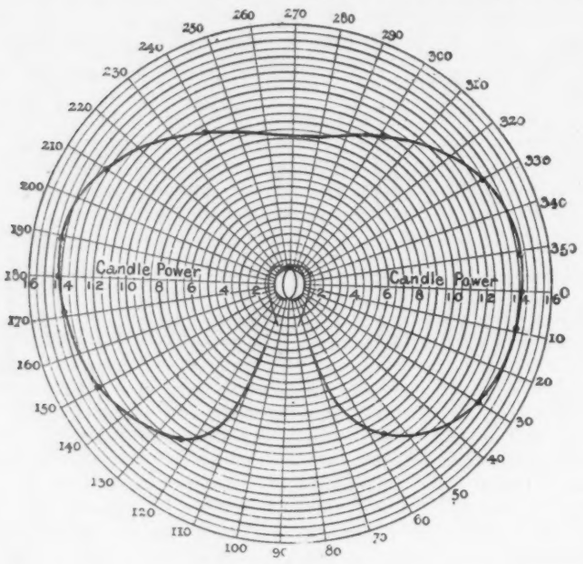


FIG. 1.—CANDLE-POWER CURVE.

watts per candle would give results so nearly consistent that all life tests could be run at this figure, enabling the length of the test to be curtailed from 400 hours to about 120 hours. A series of tests in this direction will be made. The two diagrams in Figs. 1 and 2 give the candle-power distribution curve for

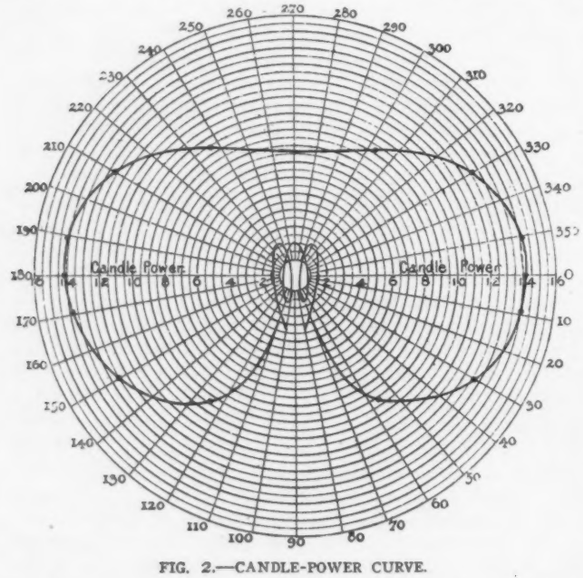


FIG. 2.—CANDLE-POWER CURVE.

looped filaments showing extreme differences in three different makes of lamp, six lamps being tested from each make, to determine the ratio of mean spherical to mean horizontal candle-power. In Fig. 1 the reduction factor is 0.90; while in Fig. 2 the reduction factor is 0.85. The author then gives some notes on some measurements made by him on mean spherical candle-power. The lamp is supposed to be fixed at the center of a sphere, and the surface of the latter is divided up into zones by 18 equidistant parallel planes at right angles to the vertical axis of the lamp. Those planes will form parallels of latitude on the surface of the sphere. Eighteen observations were made of the candle-power at intervals of 20° round each of these circles, comprising in all 324 readings for each lamp. If the average for each zone is plotted in a polar diagram the mean candle-power distribution curve for each lamp is obtained. The usual Rousseau diagram is then plotted and the ratio of the mean spherical to the mean horizontal candle-power is then deduced. The simplification by Russell was then tried according to which, by selecting the correct angles in the vertical plane, the accuracy of the results is not appreciably diminished if the sphere is divided up into very much fewer than 18 zones. In two cases examined it was found that the error introduced by taking 4 instead of 20 readings is only 2 per cent, and by taking 6 instead of 20 is only 1 per cent. The above test could have been shortened without appreciably affecting its accuracy by rotating the lamp and measuring what may be called the conical candle-power of the lamp in various directions. We may define the mean "conical" candle-power at an angle μ as the mean candle-power in a direction making an angle μ with the equatorial plane of the lamp. If readings had been taken at angles of 9.6, 30, 56.4° above and below the equatorial plane of the lamp, the mean of the six readings would have given the mean spherical candle-power with an error of about 1 per cent. This is the principle used in the Russell-Leonard integrating photometer. A voltage regulator which has been used for life tests for the last three years at the National Physical Laboratory was then described in detail. In the discussion which followed Fleming called attention to the fact that according to Paterson the Hefner unit is equal to 0.914 Pentane. On the other hand, the mean value of several determinations by Clinton gave 0.885 instead of 0.914. According to Russell the reduction factor of carbon lamps may be obtained by the aid of two measurements, namely, of the vertical candle-power and the mean horizontal candle-power. The reduction factor is 0.785 + 0.11 times the ratio of the vertical candle-power to the mean horizontal candle-power.—Lond. *Elec.*, February 8.

Alternating-Current Lamp Tests.—Haworth, Matthewman and Ogley.—A paper presented before the (Brit.) Inst. Elec. Engrs. The authors give the results of life tests made on carbon, Nernst and tantalum lamps with alternating currents. The uncertain behavior of tantalum lamps on alternating-current circuits was confirmed, but the results with the carbon and Nernst lamps were more unexpected, showing a very rapid falling off of efficiency with life. Tests were also made with 230-volt lamps overrun at 240 volts, and with lamps on a circuit the voltage of which was made to vary continually between 230 and 240 volts. All of the results are recorded in tables and curves. Of the general conclusions formulated by the authors we quote the following: "The average of the average watts per candle for the seventy carbon lamps tested is 4.86; for the eight ¼-ampere Nernst lamps tested this average is 4.14 and for the six tanlum lamps 1.97. The ordinary ¼-ampere Nernst lamp of commerce is thus about 15 per cent better than the average carbon lamp, while its life is about 560 hours. The average specific consumption for the tantalum lamps tested was 60 per cent less than that for the carbon lamps, and their lives were on an average 330 hours; doubtless the tantalum lamps made now will give much longer lives than these. Though the tantalum lamps, even on these few tests, show a much better efficiency than the carbon lamps, the makers of carbon lamps—feeling the competition of the new metal filament lamps—will, without doubt, vigorously turn their attention to the production of a 2-watt per candle carbon lamp." A short discussion followed in which Sparks said that lamps had certainly deteriorated during the past few years owing to the cheaper price for which they are now sold.—Lond. *Elec. Eng'ing*, January 14.

Mercury Vapor Lamp.—An article on the Bastian mercury-vapor lamp which is now placed on the market in France, and which is distinguished from the Cooper-Hewitt lamp since it operates on all voltages between 100 and 250, is started simply

by closing a switch, and consumes only 0.6 ampere. The arc is produced between two electrodes of mercury. The lamp shown in Fig. 3 consists of a glass tube in form of an S of

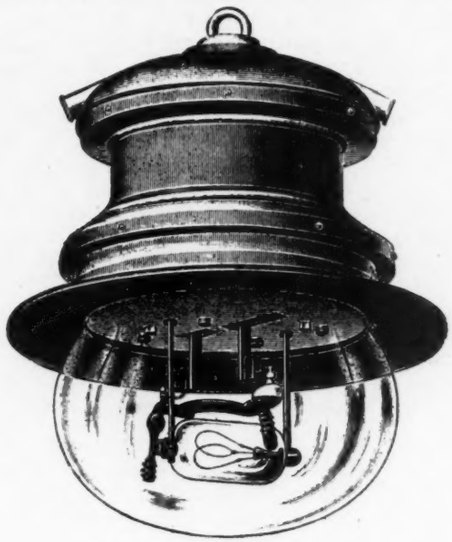


FIG. 3.—MERCURY VAPOR LAMP.

three millimeter internal diameter and of 20 to 25 centimeters length and filled with mercury. Two platinum wires lead into the mercury at the two ends of the tube. This tube is mechanically connected to the armature of an electromagnet which is electrically in series with the tube as well as two resistances and in shunt with the constant-potential supply network. When the circuit is completed, the electromagnet inclines the tube, the mercury flows down and the arc is formed. The current which is three amperes at the beginning, falls after one minute to its normal value of 0.6 amperes. There is a tendency for the mercury to pass from the positive pole to the negative pole during operation. To compensate for this effect the mercury reservoir of the positive pole has a greater cooling surface than the reservoir of the negative pole. This construction results in a greater condensation of mercury at the positive pole which compensates for the transport of the mercury in the opposite direction. The resistance of the electromagnet and of the rheostat inserted in the circuit represents about 20 per cent of the resistance of the lamp during normal operation. This resistance prevents too strong a current rush while starting the lamp. In order to improve the spectrum of the mercury vapor Bastion has tried to introduce small quantities of cadmium and sodium into the mercury. In the commercial lamp, however, as shown in the illustration, a carbon filament lamp is combined with the mercury lamp and furnishes the red rays. The life of the tube is between 3,000 and 5,000 hours. The 0.6-amp. lamps are stated to give 90 cp, but in a special article on "the incoherencies of photometry" it is pointed out that it is impossible to compare the peculiar light of the mercury vapor lamp with that of ordinary standards.—*L'Ind. Elec.*, January 25.

Mercury Vapor Lamp.—A note stating that the Allgem. Elek. Ges. in Berlin is putting a mercury lamp on the market under the name of "Dr. Arons—mercury-vapor lamp." Arons devised and used such a lamp in the early nineties for scientific physical research, but did not develop it into commercial form. *Zeit. f. Beleucht.*, February 10.

Power.

Gas Power.—CAMPBELL.—A paper read before the Leeds Section of the (British) Inst. Elec. Eng. The author gives the cost of running gas engines in generating stations and compares the results with those obtainable by steam plant. Stress is laid on the low costs obtained with suction gas and the cost is compared with those of the electric drive. Figures are given for a steam plant and a gas plant, both in Guernsey, of the same size and capacity and under the same management. From the figures given it appears that there is a saving of practically 45 per cent in the working of the gas-driven station over that of the steam-driven station. Comparative estimates are also given on the costs of driving machines by electric motors and by gas engines. An account is given of the discussion which followed and there is also an editorial on the subject. The results obtained with the two Guernsey stations are said to be not decisive, since the price of coal, although of the same quality in both cases, is cheaper at the gas station. Further the steam station has a lighting load, the gas station a power load. The output is greater in the gas station and, what is of greater importance, the average load in the case of the steam plant was 68.5 per cent of the full load, whereas that for the gas plant was as high as 86.25 per cent. It is not alone in central station work that the gas plant merits attention from electrical engineers, because the advent of suction gas has brought the gas engine into keener competition with the electric motor than was the case when illuminating gas alone was available. But the cost of gas power and that of electric power for driving machines and tools is not the only thing to be considered, since the electric motor is more efficient on varying load and requires scarcely any attention, while a gas engine must receive very much attention especially if suction gas is employed.—Lond. *Elec.*, February 8.

Pumping Plant.—An illustrated description of the new electrically driven sewage-pumping plant at Salem, Mass. There are four centrifugal pumps each direct connected to a three-phase, 125-hp induction motor.—*Eng'ing Record*, February 23.

Mexico.—An illustrated article on the 30,000-kw, 60,000-volt, three-phase power transmission system from Necaxa to Mexico. —Lond. *Elec. Rev.*, February 15.

Traction.

Single-Phase Traction Motor.—ZEHME.—An illustrated description of a large single-phase motor of the Winter-Eichberg type. The motor has a capacity of 300 hp for 80 minutes running at 400 revolutions per minute. The normal motor voltage is 850. The maximum number of revolutions per minute was intended to be 800, but it may be increased in reality to 900. The total weight of the motor including box and gearing is about 6.25 tons.—*Elek. Zeit.*, February 7.

Installations, Systems and Appliances.

London.—PEARSON.—In a continuation of his serial on electric central stations in London, the author discusses the plant of the City of London Electric Lighting Company. It is said to be "surrounded by conditions which differ from those of any other undertaking in the world." The station still contains a splendid array of single-phase alternators directly coupled to reciprocating steam engines, but when extensions became necessary in 1900 direct-current generators were installed. The station now contains four 2,000-kw direct-current machines and three each of 1,000 kw. In spite of the greater space required, reciprocating engines were installed instead of steam turbines, since the former were considered more reliable. Everything possible has been done to insure continuity of supply. The works are even provided with coal bunkers, having a capacity of 8,000 tons and being kept always full. The company claims to have captured about two-thirds of the total motor load available in London. This amounts to some 12,000 hp. The largest consumers are the newspaper printing works after which come the cold storage plants and then elevators. A substantial item of revenue is derived from electric radiators, which are fast becoming popular. Altogether there are some 2,000 four-lamp radiators connected to the company's mains, and on a cold day they increase the load at the station by as much as 500 kw. Owing to the nature of the load on the Bankside station the rules obtaining in ordinary lighting stations are completely reversed. This is obvious from the fact that the peak is a thing of the past by about 5 p. m., when offices begin to close. Hence the rates for motors are 3 cents per unit during the day and 2 cents per unit during the night. Radiators are

charged a flat rate of 3 cents per unit. Both motors and radiators are let out on the hire purchase system.—Lond. *Elec.*, February 8.

German Station.—Mulertt.—A fully illustrated description of the central station of Friedenau, a suburb of Berlin. Two Diesel engines are installed, each of 250 hp, coupled to direct-current dynamos, giving 330 amperes at 500 volts. A storage battery of 264 cells is provided with a capacity of more than 600 ampere-hours. The supply system is on the three-wire system at 2 × 220 volts. Two motor generators are provided which may be used both for charging the battery and as balancers. These latter machines are provided with interpoles.—*Elek. Zeit.*, February 7.

Motor Starter.—An illustrated description of a new type of motor starter which is called the helical drum starter. The moving contact piece or helical drum has a single thread of 1¼ turns, and it is caused to slide along a square shaft when the latter is rotated. This effect is produced by a rack mounted upon the switch base, in which the helical contact piece engages, and is thus compelled to travel endways as if held in a complete nut. Novelty is also claimed for the device, making it impossible for any part of the resistance to be left in circuit. In Fig. 4 *M* is the magnetic blow-out circuit-breaker held in by

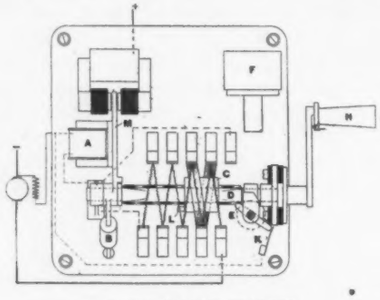


FIG. 4.—MOTOR STARTER.

the "no-volt" magnet *A* against the action of the spring *B*; *C* is the helical drum, provided with a lug *L* for engaging the circuit-breaker; *H* is the operating handle, insulated from the square shaft *D*; *K* is a small spring-actuated switch, which unless opened by hand, or by the helical drum striking the lever *E*, always short-circuits the "no-volt" magnet, the object of this switch being to prevent the starting resistance from being left in circuit. The motor is started by holding *K* open with the left hand and rotating *H* with the right in the clockwise direction, until the lug *L* engages with the circuit-breaker and closes it. The magnet, *A*, and the motor field have now been excited, and a current is passing to the motor armature through all the starting resistance. The starter being now on the first stop, the starting is continued by rotating *H* in the counter-clockwise direction until all the resistance is short-circuited and the motor brought up to full speed. If the attendant leaves the switch partially on, *K* comes into action and prevents damage to the resistance, by opening the motor circuit. The motor is stopped by giving *H* a quarter-turn clockwise, thus releasing *K* and causing the circuit-breaker, *M*, to operate. The device *F*, which operates by short-circuiting *A*, protects the motor against an overload during starting-up or when running. The mechanical slow motion of the starter prevents too rapid starting, but if an overload should be forced on the motor before it is up to full speed, the motor circuit is opened through the action of the overload device. As the circuit-breaker can only be closed by the helical drum in a position where all the resistance is in circuit, the closing of the starter with any part of the resistance cut-out is prevented. The stroke of the circuit-breaker being a short one, its spring requires to be only of moderate strength, and this enables the "no-volt" magnet to be wound with a good margin to allow for the variation in the shunt-field current of motors of different make. Its liability to get burnt out is therefore decreased. The arrangement of the starter in connection with induction motors is also described.—Lond. *Elec. Rev.*, February 15.

Rheostats.—Hallock.—After a classification of rheostats into those for series or for shunt circuits and for intermittent or for continuous service, the author distinguishes between the open type and the embedded or enclosed type of rheostat. While each type has its merits, yet where rheostats are made for all the needs of the purchasers, the open type with suitable composite units seems to be the most acceptable to the manufacurer and to the consumer alike. For starting rheostats a resistance material with a suitable positive temperature coefficient is not a disadvantage but rather an advantage. On the other hand for continuous service a resistance material with practically zero temperature coefficient is desirable. Materials having a negative temperature coefficient should be avoided except in special cases. The author gives the fundamental formulas on which to base the design both of starting rheostats and of continuous-service rheostats.—*Electric Journal*, February.

Testing the Charged Condition of Conductors.—In high tension installations devices are often desirable which show whether an apparatus or a line is charged or not. The Siemens-Schuckert Company use for this purpose the arrangement shown in Fig. 5 in which *l* represents the conductor the voltage of which

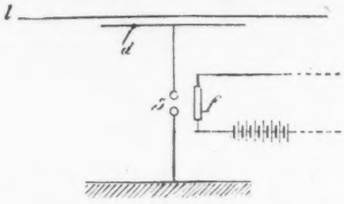


FIG. 5.—TESTING FOR ELECTRIC CHARGES.

against earth is to be tested; *d* is a short piece of wire parallel to the line *l*, and is connected to earth through the spark-gap *s*. The conditions may easily be chosen so that sparks spring over for a predetermined voltage of *l*. Under these conditions electric oscillations are produced in wires in the neighborhood which may be made to act on a coherer *f* which closes a local circuit containing a battery and bell. The bell evidently may be placed at any convenient place.—*Zeit. f. Beleucht.*, January 30.

Wires, Wiring and Conduits.

Long-Distance Transmission.—Fowler.—An article on the limiting capacities of long-distance transmission lines. The author first gives in a table figures on the effect of the resistance volts (between 5 and 20 per cent), the inductance volts (between 3 and 40 per cent), and the power factor (between 100 and 60 per cent) upon the regulation voltage. When the total power factor of the load is 100 per cent the total drop depends almost entirely upon the resistance and very little upon the inductance of the line; whereas at low power factors the inductance is a very important factor in determining the total drop. The author then gives in another table the limits of power which can be transmitted over a given line without exceeding certain limits as to voltage regulation. Figures are given for transmission lines of 50, 75, 100, 150, and 200 miles length at voltages between 20,000 and 100,000, for inductance volts of 10, 15 and 20 per cent both for a frequency of 60 and 25 cycles. The size of conductors is assumed to be such as to give approximately 15 per cent of resistance loss. The three-phase system is assumed with conductors 6 ft. apart and equidistant.—*Elec. Jour.*, February.

Calculation of Alternating-Current Lines.—Lichtenstein.—A mathematical article giving a method for calculating the e.m.f's and currents in an interlinked network with various branches. Numerical examples are taken mostly from the practice of railway lines. Since the article is mathematical, it cannot be abstracted.—*Elek. Zeit.*, February 7.

Effective Capacity of Cables.—Akermann.—An English translation in abstract, but with illustrations of the German paper, recently noticed in the Digest in which the author defines the effective capacity of any conductor of a multi-core cable and shows how to determine it by the ballistic method, the in-

vestigation being extended to cables with pilot wires.—Lond. *Elec.*, February 8.

Electrochemistry and Batteries.

Storage Batteries.—A note on a patent of the German company making Tudor storage batteries. The spongy lead of the negative electrode contracts and thus causes a loss of capacity This inconvenience may be overcome by the addition of finely powdered coke or gypsum, etc. But this can evidently only be done in the construction of new batteries and cannot be used as a remedy for batteries while in operation. In the latter case, however, it has been found that the addition of certain organic substances to the electrolyte produces the same effect. Since in time these organic substances are decomposed the addition must be renewed after a certain period. Suitable substances are glue, albumen, sugar, dextrine, oxalic acid, etc. The quantity to be added depends on the condition of the cell. As an example, it is stated that there should be added to one liter of electrolyte 5 to 10 grams of glue or albumen, 15 to 20 of sugar or dextrine, etc., but smaller or larger quantities may also be used.—*L'Industrie Electrique*, January 25.

Electrochemistry in 1906.—KERSHAW.—A review of the electrochemical and electrometallurgical industries in 1906. The article seems not to contain anything new. The last year has been one of fair prosperity in the electrolytic alkali and bleach industry; the number of works engaged in that industry is now 36 and the estimated production is 110,000 tons of 70 per cent caustic soda and 231,000 tons of 35 per cent bleaching powder per year. The number of works engaged in aluminum manufacturing during 1906 has been 11, with a capacity of 84,500 hp; the production is estimated as 12,000 tons against 8,500 tons in 1905. The total consumption of calcium carbide in Europe approaches 100,000 tons yearly; the utilization of carbide for acetylene generators continues to make progress, and the manufacture of calcium cyanamide also attracts attention. Chlorates of potash and soda and the corresponding perchlorates are made at 7 works utilizing between 30,000 and 40,000 hp. Brief notes are also given on copper, hypochlorites, ferro-alloys, nickel, sodium, tin, zinc, and the fixation of atmospheric nitrogen.—Lond. *Elec.*, February 8.

Gold and Silver.—IZART.—In a continuation of his serial on the progress of electrochemical industries, the author speaks of electrolytic precipitation of gold, the refining of precious metals, and methods of zinc plating.—*L'Ind. Elec.*, January 25.

Units, Measurements and Instruments.

Induction Ammeter and Voltmeter.—MACGAHAN.—An illustrated description of the method by which the induction ammeters and voltmeters of the Westinghouse Company are made independent of frequency and temperature. In the simplest form of an induction ammeter the rotary field is produced by a "split phase" winding." Where no corrective devices are employed, the torque is proportional to the square of the total current; to the frequency; to the characteristic losses in the iron, and to the reciprocal of the rotor resistance. As the rotor resistance is practically proportional to the absolute temperature, the torque depends upon the temperature coefficient of the rotor. To obtain a system inherently correct, it is obviously necessary to make the induction vary inversely as the frequency, and directly as the temperature. Such a circuit can be produced in a simple, automatic manner, without any corrective devices by means of the series transformer with a non-inductive, copper-resistance secondary. Assuming the current in the primary to be constant, the secondary current will be approximately constant; the more perfect the transformer, the more nearly constant; as the frequency increases, the induction will decrease in direct proportion. Also as the temperature, and consequently the resistance of the secondary coil increases, the induced voltage and consequently the induction, increases proportionally. If, therefore, the magnetism of the series transformer could be made to drive the rotor of the induction meter, the meter would be theoretically independent of the frequency and temperature within wide limits. The series-transformer principle can be made to serve the double purpose of producing a rotating field without using a "phase splitter" and of producing a field which, in conjunction with a proper rotor, will produce a torque independent of the frequency and of the temperature, within wide variations. It is found that by keeping the induction and losses very low, variations in wave form produce no appreciable effect whatever upon the torque. As actually worked out, there is an electromagnet as shown at *A* in Fig. 6, in which *A* is the

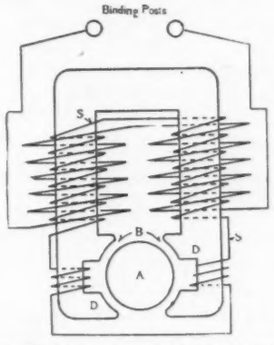


FIG. 6.—INDUCTION AMMETER AND VOLTMETER.

laminated magnetic field with an air gap *B*, in which a very light aluminum drum rotates. This drum weighs only 3.73 grammes, yet produces a torque of 2 cm. grammes at full load. The complete movement, including spring and pointer, weighs only 6 grammes. The drum is mounted on a shaft, to which also are attached, in the usual manner, the controlling spring and a pointer traveling over a scale. Jewel bearings are provided. A simpler or more rugged movement could not easily be devised. The primary winding is shown in the diagram by lines *P*, the secondary by lines *S*. To vary the capacity of the meter, the number of primary turns and size of wire, only, need be changed. In voltmeters, many turns of fine wire are used in the primary, in conjunction with a separate high-resistance wire of zero temperature coefficient. The secondary coil is wound directly under the primary and is connected to the auxiliary coils on the pole pieces, *D-D*. These poles thus form in effect a two-phase bi-polar rotary field. The induction is sufficiently high to make the damping effect cause the indications to be "dead beat" without the use of additional damping magnets. The frequency error of the ammeters is practically negligible between 2,000 and 8,000 alternations, as shown in Fig. 7,

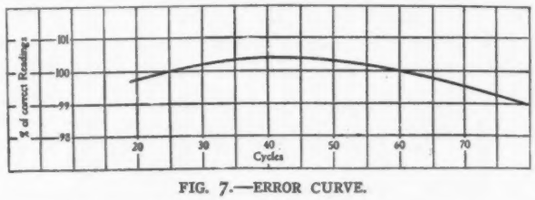
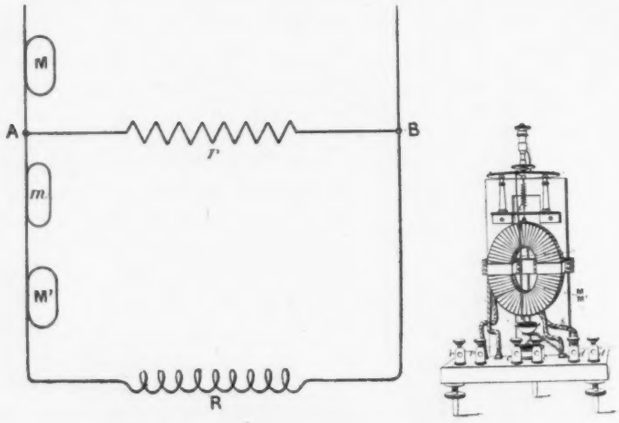


FIG. 7.—ERROR CURVE.

and the temperature coefficient varies in individual meters from +0.01 per cent to —0.01 per cent. The voltmeters are only slightly inferior in frequency errors to the ammeter and quite as good as regards temperature.—*Elec. Jour.*, February.

Differential Electro Dynamometer.—TELLIER.—An illustrated article on the use of the Potier differential electrodynamometer for measuring power in alternating-current circuits. In most cases of practice the alternating-current curves differ more or less from the sinusoidal form. The dynamometric method of Potier, which gives results independent of the frequency, power factor and wave form, will be able to render good services in such cases where the ordinary wattmeter would give doubtful results. The principle of Potier's method is indicated in Fig. 8, which shows two fixed coils, *M* and *M'*, exerting a differential action on the movable coil *m*. If the power of the circuit *R* is to be measured, *m* and *M'* are connected in series with *R* so that the circuit *ARB* is formed. *A* and *B* are connected through a non-inductive resistance *r* and in one of the feeders the secondary stationary coil *M* is inserted. The movable coil is sus-

pended by means of a torsion spring. When no current flows through R, the plane of m is perpendicular to the plane of the windings of the stationary coils. When direct or alternating current passes through R, the movable coil, m, is deflected and the power, P, in the circuit ARB equals kra, where a is the deflection of the coil, r, the resistance between A and B (measured by the voltage between A and B and the current) and k is a constant which depends only on the form of the coils and the dimensions and the elasticity coefficient of the spring. Since



FIGS. 8 AND 9.—DIFFERENTIAL ELECTRODYNAMOMETER.

the differential electrodynamometer is in series with the circuit in which the power is to be measured, the only limit of its application is the maximum current which the coils are able to carry. The elastic coefficients of the spring will be chosen so that they are not changed by the torque corresponding to the maximum current. The instrument may be used at very different voltages. In this respect one is limited only by the non-inductive resistance r to be inserted between A and B. Fig. 9 shows an instrument of this type which has been built in the University of Lille. The two stationary coils, M and M', have each 10 turns and are placed in the interior of the movable coil m, which is a vertical copper conductor of rectangular form suspended by a cocoon thread and fixed in direction by a torsion spring. The current is introduced into this coil through two mercury cups placed above each other in the axle of rotation. The calculation of the instrument is given with some remarks on its construction and calibration. It may be used for all measurements of power in general. Practically it is superior to the three-ammeter method and the three-voltmeter method, but it is inconvenient in requiring three different readings and it also requires a non-inductive resistance through which very strong currents pass. It is specially valuable for experimentally testing commercial wattmeters in order to study the effect of power factor, frequency and wave form. Results of such tests are given. *L'Ind. Elec.*, January 25.

Self-Regulating Brake.—Scheibe.—The principle is shown in the left-hand diagram of Fig. 10. The equal weights, W_1 and W_2 supply the tension that makes the strap grip the pulley, and the torque thus developed is balanced by the weight W_3. The automatic feature of the device consists in the special construction of the strap used. It may be made of any flexible material with a good friction surface, but from its center to one end it should be provided with a flexible metallic surface on the side that is to face the pulley. Such a strap may be readily made from a piece of leather belting studded with copper rivets, as indicated in the right-hand diagram. For accuracy at light loads the belt must be quite flexible. The operation of the device is apparent from the sketch. W_3 is placed on the end of the strap provided with the metal surface and hung from the rising side of the brake pulley. If the torque developed overbalances W_3 this weight will rise and the strap shift on the pulley, until more copper and less leather are in contact with the pulley rim. This lowers the average coefficient of friction to a point that will just balance W_3 so that the amount of this weight determines the torque to which the brake will adjust itself. The difference in the friction coefficients of leather and copper is so large that a wide range of torque may be obtained without changing W_1 and W_2. For example, in one test with a one-inch strap on a four-inch pulley, with W_1 and W_2 each one-half pound weights, it was found that on changing W_3 from one-half to five pounds, the belt moved only about two and one-half inches. This was a ratio of one to ten, which is amply wide for ordinary purposes, as the usual range in shop testing of motors is from one-fourth to one and one-half full load, or

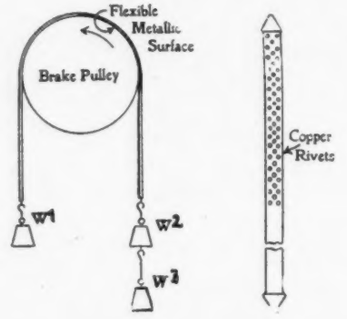


FIG. 10.—SELF-REGULATING BRAKE.

one to six. The automatic feature of this device takes care of all changes in the friction surface due to variable temperature and other causes.—*Elec. Jour.*, February.

Potentiometer.—Taylor.—In a continuation of his serial on the standardizing laboratory, the author describes in detail a potentiometer method of calibrating standard wattmeters. The article is fully illustrated.—*Elec. Jour.*, February.

Polyphase Meters.—Rypinski.—A knowledge of the conventions followed by the manufacturer in the bringing out of leads and terminals on meters and meter transformers is often of great assistance in the making up of diagrams of connections and in locating the cause of trouble in existing installations. The author outlines briefly some features of Westinghouse apparatus bearing on this matter. The article is illustrated by numerous diagrams.—*Elec. Jour.*, February.

Railway Signaling.—Cadwallader.—A continuation of his illustrated serial dealing with electro-pneumatic interlocking systems.—*Elec. Jour.*, February.

Telegraphy, Telephony and Signals.

Wireless Telephony.—Fessenden.—The first part of a serial on this subject. The author discusses the present status and the future prospects of wireless telephony and gives some historical notes. The author thinks that in addition to its use on shipboard, wireless telephony will have a real commercial field in long-distance telephony.—Lond. *Elec. Rev.*, February 15.

Miscellaneous.

Copper.—Welbourn.—A general discussion of the present situation, characterized by the great demand of copper compared with the supply. The reasons are said to be that some of the best managed mines now scrap old and inefficient plant to install new machinery and that the supply thereby suffers; there is further a shortage of labor and of railway cars. As to the possible sources of relief there may be perhaps a diminished consumption of copper in the electrical industry, but the chief source of relief must be looked for from increased outputs of existing mines and from the opening of new ones.—Lond. *Elec. Eng'ing*, February 14.

BOOK REVIEW.

THEORETISCHE ELEKTROCHEMIE. By Dr. Heinrich Danneel. Leipzig: G. J. Goschen'sche. 16 mo., 197 pages. 18 illustrations. Price, 80 pfennigs.

This is an issue of the Göschen collection of scientific literature, selling, neatly bound in cloth, at the unnatural price of twenty cents. The print is excellent, arrangement of contents logical and the *ensemble* completely satisfactory. The seven chapters discuss the conception of work; elements of electrical energy; chemical equilibrium, static and dynamic; the dissociation theory; conductivity; electromotive force; polarization and electrolysis; the electron theory. The whole is written in a masterly and lucid manner, comprehensible to anyone knowing the elements of chemistry and physics. Questions of theory are explained according to the prevalent, but contested, theory of electrolytic dissociation.

Automatic Shutter for Electric Fans.

The Ilg Electric Ventilating Company, 221 E. Kinzie Street, Chicago, is just putting on the market an automatic shutter for use in connection with its motor-driven fan ventilating systems. As is well known, it is frequently desirable, especially

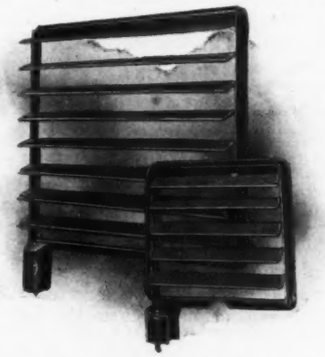


FIG. 1.—SHUTTER FOR FANS.

in cold weather, to close the discharge opening of ventilating fans when they are not in operation in order to prevent currents of cold air from coming in the ventilating duct. In order to do this automatically and without extra attention beyond that required to start and stop the motor, the shutter illustrated in Figs. 1 and 2 has been devised. Fig. 1 shows two sizes of

FIG. 2.—SHUTTER FOR FANS.

shutter as they appear when open. Fig. 2 shows them closed. The slats are of aluminum and the shutter is operated by a solenoid seen in the iron case at the lower left-hand corner. This is simply placed in series with the motor circuit, so that when the motor is operating the plunger of the solenoid is drawn in and this opens the shutter. When no current is flowing, the shutter closes. These shutters can also be arranged to open with the force of the air current from the fan, and drop shut automatically by gravity. The shutters are made to be used in connection with ventilating fans of 16 to 60 in. in diameter.

Two Induction Motor Installations in Havana, Cuba.

That manufacturing interests in Cuba have not been slow to realize the advantages of electricity for power purposes, is indicated by the increasing exports of electrical apparatus to that country. This is especially true of induction motors, two recent applications of which in Havana—one from a viewpoint of economy alone, the other from consideration of novelty as well as economy—may prove of interest.

Fig. 1 shows a 15-hp induction motor installed in the cigar box factory of Messrs. Diaz & Vega. This motor operates, through a line shaft, a large number of small circular and jig saws on the first and second floors of the establishment. The interesting part of the installation resides in the fact that a steam engine and boiler costing to install some $3,500, although still new, were replaced by the motor above noted at a fraction of the cost of the steam plant.

The new "Centro Dependiente" Club house now being built on the Prado, Havana, will be, when finished, both the largest

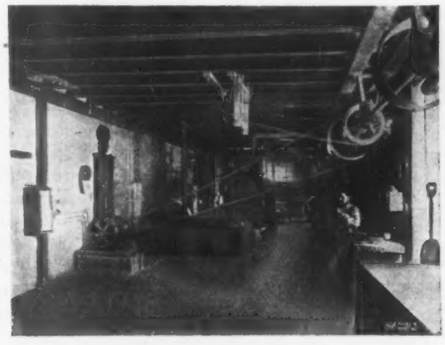


FIG. 1.—INDUCTION MOTOR IN CIGAR BOX FACTORY.

and most costly building on the Island of Cuba. Large quantities of marble tiling are being used in the construction of the floors and staircases, for the rapid installation and finishing of which the "rubbing bed and tiling machine," shown in Fig. 2, was devised. This machine is operated by a 15-hp induction

FIG. 1.—MOTOR-DRIVEN RUBBING BED.

motor. It is interesting to note that four men working at the electrically-driven "rubbing bed" can accomplish in one day what formerly would have required a week with the same number of operators using older methods.

Both of the motors mentioned were sold through Messrs. Sussdorf, Zaldo & Co., Cuban agents for the General Electric Company.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Reports from all sections indicate improvement in trade, due largely to the more favorable weather conditions and the arrival of country merchants at the leading business centres. Manufacturing is generally active and finished lines of iron and steel are brisk, though pig-iron markets are quiet. Winter-wheat returns are not so favorable, the Texas crop being practically a failure owing to the ravages of the green bug, while in the central-west belt considerable of the plant looks as if it had been winter-killed. West of the Missouri, however, the crop is in a favorable condition. Shipments of fertilizers to southern points are heavier, and a largely increased acreage will be planted to cotton. Collections are somewhat backward, owing partly to delayed deliveries, partly to the immense volume of business being carried on, and partly to the comparative scarcity of money. Pig-iron markets continue quiet. Steel-making irons are scarce, and, in fact, it is estimated that not more than 15,000 to 20,000 tons will be available in the Pittsburg market prior to July 1. Finished lines are very active. Structural material is in better demand. A feature of the week was an order for 8,600 tons of bridge material for a Manchurian railway, which about three weeks ago contracted with our mills for 50,000 tons of 80-lb. steel rails. Light steel rails are up $2 a ton. In copper, considerable business was placed for delivery in April and May. Premiums are increasing for anything like prompt supplies. The international markets were strong and lively. Prime lake was active at the close of the week at 26@26¼c. for April and May. Proffers for June are numerous, but producers are not ready to book for that month. Electrolytic is in increasing demand at 25 to 25½c. for May and June. Casting copper, sixty days, is at 24¾ to 25¼c. *Bradstreet's* reports 194 business failures during the week ending February 28, as against 177 in the week previous and 180 the corresponding week last year.

ROANOKE POWER PLANT.—Mr. J. W. Hancock, the general manager of the Roanoke, Va., Railway & Electric Company, informs us with regard to the new power plant noted in these pages last week that the building will be of concrete block, covering a floor area of 90 by 140 ft. It is so designed that when the growth of the business justifies it, the capacity of the building can be doubled. The main part of the building containing the steam turbines and electrical generators will be 90 ft. front and 60 ft. in depth. The initial equipment will consist of one 1,500-kw turbo-generator and two 500-kw turbos. This building will also contain the rotaries for running the railway, transformers for street arcs, switchboards, etc. The boiler room in the rear of the main part of the building will be 80 ft. by 80. There will be installed four 500-hp boilers with mechanical stokers and coal handling arrangements. This room will be large enough for installing four additional boilers of the same size, if required. The main room will also be of sufficient capacity to receive further turbo units, so as to double the first installation. The architect of the building is Mr. Aubrey Chesterman, of Lynchburg, Va.

IRON PANEL BOXES.—H. T. Paiste Co., of Philadelphia, announce that they completed arrangements recently whereby they became exclusive manufacturers of sectional iron panel boxes under the Le Manquais patents. They have been interested in these boxes for some time, on account of their being a necessary part of panel-board work, using Paiste panelettes and panel cut-outs, and believing, too, that the sectional feature and certain other details of their design resulted in a line of wiring specialties of value to the wireman. The factory of the Le Manquais Electrical Manufacturing Company was at Belle Mead, N. J. This factory has been moved to Philadelphia, and combined with the Paiste factory. H. T. Paiste Co. have retained Mr. E. R. Le Manquais to give his personal supervision to the panel box making, insuring a continuance of uniformity and excellence of output. The February "Paistery" gives technical details as to the product.

TELEPHONY IN MICHIGAN.—Incorporation papers for the Interstate Long Distance Telephone Company, with a capitalization of $15,000,000, have been filed at Lansing. The new company will have central offices in Detroit. It is organized for the purpose of building a long distance telephone system throughout Michigan, connecting with the various independent systems of Michigan, Ohio and points east and west. It is said that work will be begun immediately on sixty telephone circuits, embracing more than 3,000 miles of wire, and it is expected that $1,500,000 will be expended in construction work during the coming season. The directorate of the new company will also compose part of the directorate of the Home Telephone Company, the independent system which is being constructed in Detroit.

THE JACOBSON MACHINE MFG. CO., of Warren, Pa., has completed all arrangements with a new corporation organized in Rock Island, Ill., incorporated as the Rock Island Tool Co., providing for the complete transfer of the Jacobson Machine Mfg. Co. vise business. The Jacobson people have built up a good trade on these automatic vises, and as they are taxing their capacity with gas and gasoline engine work they consider it advisable to divide the business in this way. The Jacobson Company will retain a considerable interest in the new concern, and as those engaged in the management of the new company are accustomed to manufacture of this kind the Jacobson vise business will be well take care of. The new concern expects to be under way by April 1.

FLAMING ARC LAMPS AT ERIE TERMINAL.—The progressive spirit of the management of the new Erie management is well illustrated by the illumination of their new terminal at Twenty-third Street, New York. After careful consideration, their electrical department selected the Excello flaming arc for lighting the ferry slips, cab stands and concourse. Although there are only comparatively few lamps installed, the results, particularly as regards lighting efficiency, have been highly satisfactory, both to the patrons and officials of the road. Excello arcs are used in this installation, both for inside and outside illumination. Additional similar installations are being made at the Chambers Street and Jersey City terminals.

PLANT IN OREGON.—The Edwin G. Amme Company, of Portland, Ore., has secured a franchise to install a lighting and power plant at Bandon, Coos County, Oregon. It will operate this in conjunction with other plants that it controls. Construction has already been started, and the equipment will comprise a 1,500-kw, three-phase, 2,300-volt generator, direct-connected to a Corliss engine; and water tube boilers. The Bandon Electric Company is incorporated for $10,000 and is composed of Edwin C. Amme, Clayton E. Hollopeter and W. H. Hollopeter, all of Portland, Ore., where the Amme concern has its headquarters.

BELL TELEPHONE OUTPUT.—The American Telephone & Telegraph Company's instrument statement for the month of January is as follows:

	1907.	1906.	1905.	1904.
Gross output ...	174,306	176,607	130,634	90,644
Returned	77,407	63,224	37,700	36,854
Net output ..	96,899	113,383	92,934	53,790
Total outstanding	7,204,735	5,811,641	4,573,498	3,833,307

MASSACHUSETTS CHEMICAL COMPANY, of Walpole, Mass., the manufacturers of insulating compounds, paints, etc., rubber specialties, etc., finds itself compelled by pressure of business to build a large addition to its factory, practically doubling the capacity of its plant. It has equipped it with the best of modern rubber machinery, and will be enabled to handle orders more promptly than heretofore.

SELLERS & RIPPEY, consulting engineers, Philadelphia, have awarded contract for turbines for the Bar Harbor & Union River Company's plant at Ellsworth, Me., to S. Morgan Smith Company, York, Pa. Mr. J. A. Leonard, Ellsworth, Me., is the engineer.

FLEXIBLE CORD INSPECTION.—The Wire Inspection Bureau, affiliated with the Underwriters' Laboratories, has issued a circular letter under date of March 4, as to flexible cord inspection. The general tenor of it is as follows: After several conferences between joint committee formed by representatives of the insurance interest and the advisory committee of the flexible cord manufacturers, it was deemed advisable to devise ways and means of testing all flexible cord, both pendant and portable, manufactured under the rules of the National Board of Fire Underwriters, as recommended by the Underwriters' National Electrical Association. This to restrict the introduction into commercial use of any cord which would prove inferior to the N. E. Code standard, so as to protect reliable manufacturers against inferior goods, in competition. Specifications for these factory tests have been drawn up by the above committee and are as follows: "Each coil of duplex cord shall be tested dry by the application of 1,500 volts alternating current, simultaneously to each of the two conductors; contact being made on bare copper wires at either end of the coil, and care being taken that the other ends of the conductors do not come together. Alternating current is to be supplied from a transformer with an actual working capacity of at least 5 kilowatts." These factory tests will be conducted in a similar manner to those now carried on under directions of the W. I. B., in the manufacture of N. E. Code rubber covered wire. Stamps will be issued by the Wire Inspection Bureau and sold to the different manufacturers at a charge of 2½ cents per thousand running feet of cord tested. These stamps to be attached to the coils of tested cord by the manufacturers themselves, and to serve as a guarantee that cord so stamped has successfully withstood the tests specified by the Bureau. They will be furnished for 250 ft., 500 ft., and 1,000-ft. coils, as desired. The majority of flexible cord manufacturers have recently agreed that, on and after March 1, 1907, all National Code cord manufactured by their companies will be made up under the new specifications and duly tested, and will bear identification mark of the W. I. B. It is understood that a reasonable time will be allowed, after this date, for the disposal of code cord not bearing the stamp of approval of the Wire Inspection Bureau, on all such cord manufactured before March 1, 1907, and with this understanding, the April List of Electrical Fittings will contain the names of flexible cord manufacturers agreeing to the tests of the Wire Inspection Bureau, and using stamps as guarantee that these tests have been properly made. No cord will be considered as having been tested which does not carry an identification stamp. Stamps to be securely fastened to the shipping tags attached to the coils. These stamps will have serial numbers and, on coils of less than standard lengths, where stamps specify more cord than coil contains, a credit for excess in stamp value can be obtained from the W. I. B. on presentation of the facts in writing, giving size of cord, destination, number of feet and serial number of stamp used. All stamps are to be canceled by manufacturer when used, the date of manufacture of cord, also, being plainly shown.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was nervous and irregular throughout the week, prices only partially recovering from a decided depression due to the revelations made before the Interstate Commerce Commission regarding Union Pacific and Alton affairs. The passage of the Aldrich bill by the Senate, while favorably regarded, had little actual effect. The liquidation of weak accounts at the declines was also quite heavy, and though the short interest was manifestly greatly enlarged, the market did not seem to become oversold to such a degree that a sustained rally could be engineered. The industrial list also suffered in sympathy with the action of the general market, despite a feeling in many quarters that stocks of this class are in many cases entitled to do better in view of the fact that they are not in any degree subjected to the same adverse influences which now affect different railroad properties. The Steel stocks were rather steady without developing much activity, but Amalgamated Copper was lower on large transactions, and some notable breaks occurred in industrial specialties, especially in Colorado Fuel & Iron. Electrics and tractions were all weak and little dealt in, in most cases the lowest prices of the year being touched. Western Union was quoted at 81 at the end of the week—this being a loss of two points. General Electric was 1 point lower, and Allis-Chalmers declined 1 and 2¼ points respectively for common and preferred. Trading on the curb was generally marked by receding prices, closing quotations, as a rule, being below those of the week previous. Following are the closing quotations of March 5:

NEW YORK

	Feb. 26	Mar. 5		Feb. 26	Mar. 5
Allis-Chalmers Co.	12¾	12⅝	General Electric	167	163
Allis-Chalmers Co, pfd.	34½	33	Hudson River Tel.	...	...
American Dist. Tel.	...	...	Interborough Met. Com.	33¼	28½
American Locomotive	72¼	68¾	Interborough Met. pfd.	70¾	63
American Locomotive pfd.	111	108⅝	Mackay Cos.	...	70⅝
American Tel. & Cable.	83	80	Mackay Cos. pfd.	...	68¾
American Tel. & Tel.	...	...	Marconi Tel.	...	...
Brooklyn Rapid Transit	71⅜	56	Metropolitan St. Ry.	...	...
Electric Boat	30	30	N. Y. & N. J. Tel.	...	...
Electric Boat pfd.	...	80	Western Union Tel.	81⅛	80⅝
Electric Vehicle	...	...	Westinghouse com.	150½	150
Electric Vehicle pfd	...	...	Westinghouse pfd.	...	...

BOSTON

	Feb. 26	Mar. 5		Feb. 26	Mar. 5
American Tel & Tel.	126	125¼	Mass. Elec. Ry. pfd	68	66
Cumberland Telephone	109	110	Mexican Telephone	4	4
Edison Elec. Illum.	224	...	New England Telephone	122	120
General Electric	156⅞	155	Western Tel. & Tel.	...	...
Mass. Elec. Ry.	19	18	Western Tel. & Tel. pfd.	...	...

PHILADELPHIA

	Feb. 26	Mar. 5		Feb. 26	Mar. 5
American Railways	50⅛	50⅝	Phila. Electric	8	7⅞
Elec. Co. of America	10	10	Phila. Rapid Trans.	20⅛	20
Elec. Storage Battery	60	53	Phila. Traction	93⅞	92¾
Elec. Storage Battery pfd.	...	...			

CHICAGO

	Feb. 26	Mar. 5		Feb. 26	Mar. 5
Chicago City Ry.	150	150	National Carbon	80	80¼
Chicago Edison	...	...	National Carbon pfd.	115	115¼
Chicago Subway	25	27½	Union Traction	...	...
Chicago Tel. Co.	...	...	Union Traction pfd.	...	...
Metropolitan Elev com.	25	24¼			

NATIONAL CARBON ANNUAL.—The National Carbon Company has presented its annual report for the year ended January 31, 1907. Material gains were recorded in net earnings and surplus, while the amount earned on its common stock, before charging off depreciation, was equivalent to 11.56 per cent and the surplus, after deducting charges, equalled 4.71 per cent. Net earnings during the last fiscal year aggregated $951,078, a gain of $60,314. As the preferred dividend disbursements were unchanged, amounting to $315,000, the balance amounted to $636,078, or equivalent to 11.56 earned on the common stock. Common dividends were $220,000, an increase of $27,500, leaving a balance of $416,078, an increase of $32,814. Depreciation charges aggregated $376,966, an increase of $23,453, and the surplus amounted to $39,112, an increase of $9,361. The income account for the last fiscal year compares with these of the two previous years as follows:

	1907.	1906.	1905.
Net earnings	$951,078	$890,764	$846,307
Preferred dividends	315,000	315,000	315,000
Balance	$636,078	$575,764	$531,307
Common dividends	220,000	192,500	82,500
Balance	$416,078	$383,264	$448,807
Depreciation, etc.	376,966	353,513	383,336
Surplus for year	$39,112	$29,751	$65,471

The general balance sheet January 31, 1907, showed assets of $10,725,015, including real estate, plants, merchandise, manufactured and unmanufactured; cash, construction under contract, cash reserved for betterments, cash reserved for preferred dividends and bills and accounts receivable.

UNION SWITCH & SIGNAL.—The Union Switch & Signal Company has issued an excellent report for 1906. Large gains were recorded for gross and net earnings, and net profits amounted to $1,055,332, an increase of $642,655 over those for the previous year, and equivalent to 47 per cent earned on both common and preferred stock. The company's gross income aggregated $5,065,675, an increase of $2,086,524, while its interest charges and other deductions involved $4,010,343, an increase of $1,440,859. The surplus for the year on December 31, 1906, was $1,956,287, compared with $1,026,033 at the close of 1905. The stockholders have been offered the right to subscribe for 5,000 shares of additional common stocks at $80 per share, which involves a premium of $30. The books close March 12. The income account of the company for last year, compared with those of the two previous years, follow:

	1906.	1905.	1904.
Gross income	$5,065,675	$2,979,151	$2,486,840
Interest and other deductions	4,010,343	2,569,484	2,127,999
Net profits	$1,055,332	$409,668	$358,841

DECEMBER EARNINGS.—Stone & Webster report the earnings of the following companies for the month of December, 1906, as follows:

CAPE BRETON ELECTRIC CO., LTD.			
December gross	$23,693	$21,685 Inc.	$2,008
Net	10,084	8,917 Inc.	1,167
Surplus over charges	5,834	4,567 Inc.	1,267
EL PASO ELECTRIC CO.			
December gross	$41,575	$28,103 Inc.	$13,472
Net	10,571	9,463 Inc.	1,108
Surplus over charges	6,384	5,660 Inc.	724
GALVESTON ELECTRIC CO.			
December gross	$27,257	$22,601 Inc.	$4,656
Net	9,686	8,541 Inc.	1,145
Surplus over charges	5,519	4,374 Inc.	1,145
HOUGHTON COUNTY ELECTRIC LIGHT CO.			
December gross	$27,512	$26,084 Inc.	$1,428
Net	16,690	16,510 Inc.	180
Surplus over charges	13,877	13,698 Inc.	179
HOUSTON ELECTRIC CO.			
December gross	$54,117	$46,413 Inc.	$7,704
Net	21,244	16,619 Inc.	4,625
Surplus over charges	10,915	5,497 Inc.	5,418
JACKSONVILLE ELECTRIC CO.			
December gross	$31,882	$23,618 Inc.	$8,264
Net	13,572	8,529 Inc.	5,043
Surplus over charges	10,097	5,204 Inc.	4,893
LOWELL ELECTRIC LIGHT CORPORATION.			
December gross	$28,651	$27,530 Inc.	$1,121
Net	13,534	12,961 Inc.	573
Surplus over charges	11,737	11,518 Inc.	219
MINNEAPOLIS GENERAL ELECTRIC CO.			
December gross	$87,000	$77,894 Inc.	$9,106
Net	37,472	34,431 Inc.	3,041
Surplus over charges	28,564	25,360 Inc.	3,204
TAMPA ELECTRIC CO.			
December gross	$41,161	$37,353 Inc.	$3,808
Net	12,194	16,523 Dec.	4,329
Surplus over charges	11,513	15,570 Dec.	4,057
TERRE HAUTE TRACTION & LIGHT CO.			
December gross	$83,271	$61,062 Inc.	$22,209
Net	39,416	21,385 Inc.	18,031
Surplus over charges	23,820	9,186 Inc.	14,654
WHATCOM COUNTY RAILWAY & LIGHT CO.			
December gross	$28,903	$23,311 Inc.	$5,592
Net	11,760	8,708 Inc.	3,052
Surplus over charges	5,546	4,804 Inc.	742

DOMINION POWER & TRANSMISSION.—Perry, Coffin & Burr and N. W. Harris Co. are offering $1,650,000 of the 5 per cent gold bonds of the new Dominion Power & Transmission Company, Ltd., which has taken over all the water power, lighting and traction interests at Hamilton, Ont. The various plants earned gross in 1906 no less than $1,039,341, and $409,897, the surplus earnings applicable to dividends after payment of bond interest being $237,264. There is outstanding $7,692,300 stock and $5,592,550 bonds, including the above amount now offered, the remainder being the bonds of the subsidiary companies. To enable the company to still further develop its rapidly growing business, and also to provide for the purchase and retirement of the present mortgage indebtedness of several of the subsidiary companies, the Dominion Power & Transmission Company, Ltd., has authorized an issue of $25,000,000 5 per cent gold bonds. The escrow bonds may be issued under conservative restrictions, and only then with the consent and approval of the Harris Trust & Savings Bank, Trustee. Of the escrow bonds, $4,350,000 may be issued for not exceeding 80 per cent, and the remainder for not exceeding 75 per cent of the cash cost of extensions and additions to the properties of the company, or of the cost of acquiring not less than a controlling interest in the capital stock of other properties, or they may be issued at par for the actual cash cost of purchasing or retiring bonds of controlled properties. It is provided further that not more than $4,500,000 bonds, except for purchasing or retiring the bonds of controlled corporations as mentioned above, shall be issued unless the net earnings for the preceding year shall have been equal to at least one and three-quarters times the annual interest on all the outstanding bonds of the company, including bonds of controlled companies, together with those proposed to be issued.

WOONSOCKET LIGHTING DEAL.—Mr. Frank E. Holden has become master of the lighting situation in Woonsocket. He is president of the Woonsocket Gas Company, and interests allied with that corporation and represented by Mr. Holden have purchased a controlling interest in the Woonsocket Electric Machine and Power Company, the price paid being $155.15 a share. The latter bid was made in competition with interests represented by Arthur B. Lisle, of Providence, and is an increase of $15.15 a share over the bid made previously by the interests represented by Mr. Holden. Mr. Lisle's bid was $151.63 a share. If the Holden interests get all the electric light stock, as now seems probable, they will pay $775,750 for 5,000 shares, representing the capitalization of $500,000 at $100 a share.

CANADIAN BELL TELEPHONE.—The Bell Telephone Company of Canada, has issued its annual report for year ended December 31, 1906, as follows:

	1906.	1905.	1904.	1903.
Gross	$4,139,334	$3,517,595	$2,933,653	$2,522,275
Expenses	3,146,479	2,615,276	2,231,748	1,940,124
Net	$992,855	$902,318	$701,905	$582,151
Divs.	726,677	650,215	588,117	467,510
Surplus	*$266,178	$252,103	$113,787	$114,641

*From this amount $205,141 was charged off for contingent fund, accident reserve and insurance reserve, leaving a balance of $61,037 carried to profit and loss surplus. The contingent fund now totals $2,790,322.

NEW YORK STATE TELEPHONY.—The annual reports of the Central New York, Empire State and New York & Pennsylvania telephone companies for the year ended December 31, 1906, have been issued in Boston. These three small companies operate in the central and southern part of New York state. The income accounts of the three companies are as follows:

	N. Y. & PA.	CEN. N. Y.	EMP. STATE.
Gross	$636,945	$642,435	$168,036
Expenses	501,368	652,602	220,342
Net	$135,577	*$10,167	*$52,305
Interest	124,614	132,006	72,655
Balance	10,962	*143,006	*124,960
Stations	32,514	32,759	12,099
Increase	4,950	9,253	3,173

*Deficit.

DIVIDENDS.—The Waterbury Company of New Jersey has declared the regular quarterly dividend of 2 per cent on its preferred stock and a quarterly dividend of 2½ per cent on its common stock, payable April 1. Practically all of the dividend on the common stock is received by the Waterbury Company of West Virginia, and that company has declared a regular quarterly dividend of 1 per cent. The regular quarterly dividend of 1¾ per cent on the stock of the Metropolitan Street Railway Co., paid as rental by the New York City Railway Co., will be payable April 1. Directors of the Multiphone Operating Co. have declared the regular monthly dividend of 1 per cent, payable March 1.

MISSOURI BELL TELEPHONE.—The income account of the Bell Telephone Company of Missouri, for the fiscal year ended December 31, 1906, is as follows:

Gross earnings	$1,669,811
Operating expenses	1,252,014
Net earnings	$417,797
Dividends	416,368
Balance	$1,431

The company is preparing to issue $2,038,000 new stock at par, bringing its outstanding capital stock up to $8,788,000.

PENNSYLVANIA TELEPHONE.—The Pennsylvania Telephone Company has issued its full report for the year ended December 31, 1906, as follows:

	1906.	1905.	1904.
Gross	$1,243,195	$1,093,970	$958,486
Expenses	957,751	845,395	742,397
Net	$285,444	$248,575	$216,089
Dividends	212,365	179,569	160,609
Surplus	$73,079	$69,006	$55,480

PITTSBURG TELEPHONY.—The directors of the Central District & Printing Telegraph Company, of Pittsburg, have authorized an increase of the capital stock of the company from $11,000,000 to $13,000,000. The proceeds to be used for the payment of the debt of the company and for extensions and additions to the plant proposed for the coming year.

ACQUIRING STEAM ROAD.—The Buffalo & Lake Erie Traction Company has applied to the Board of Railroad Commissioners for authority to increase the capital stock from $6,750,000 to $7,500,000, to acquire the stock of the Jamestown, Chautauqua and Lake Erie Railway, the latter being a steam road.

CINCINNATI TELEPHONE STOCK.—The Cincinnati Suburban Bell Telephone Company has voted to increase its capital stock from $5,000,000 to $8,000,000.

GENERAL NEWS.

Construction News.

YUMA, ARIZ.—The Yuma Electric & Water Company is contemplating doubling the capacity of its plant in this city.

EUREKA, CAL.—It is reported that N. H. Falk is interested in a project to build an electric railway from Eureka to Arcata. The promoters of the road estimate that the line can be constructed and equipped at a cost of about $100,000.

FRESNO, CAL.—S. N. Griffith, who promoted the Fresno electric system, is interested in a project to build a direct railway from Coalinga to Fresno. A survey of the line will soon be made.

HUNTINGTON, CAL.—A committee has been appointed by the Santa Ana Chamber of Commerce to assist the Huntington Beach Company, which proposes to build an electric railway from Huntington to Santa Ana.

MERCED, CAL.—W. A. Merwin, of Irwin City, has made application for a franchise for an electric railway from the Stanislaus county line to Irwin City, a distance of three miles.

MONTEREY, CAL.—The Monterey County Gas & Electric Company is remodeling its electric power plant at Monterey. It is now in the market for a 1,500-kw turbo-generator set. The company owns and operates the Monterey & Pacific Grove Railway Company, and is increasing the capacity of its plant to meet the demands that will be made upon it when the electric road is extended to Salinas. George Heazelton, Kohl Building, San Francisco, is one of the new owners.

REDONDO, CAL.—The Pacific Light & Power Company has petitioned the Council for a franchise for a system of pole lines.

SACRAMENTO, CAL.—Charles Carpy, president of the French-American Bank, of San Francisco, has applied to the City Council for a franchise for another electric railway in Sacramento. The applicant asks that bids be received for the franchise, and also submitted an ordinance to be adopted by the Council.

SAN FRANCISCO, CAL.—The Board of Supervisors will receive bids until March 23, for the proposed crosstown electric car line to connect Scott and Page Streets with the Mission. The board has also passed an ordinance granting the Presidio Railway Company nine months' time to complete the conversion of the Union Street cable road into an electric system under a bond of $50,000.

SAN JOSE, CAL.—The George McKee Paint Company is planning an addition to its plant and will use electricity for operating the machinery of the plant.

SONORA, CAL.—A. H. Klenecke has petitioned the Toulumne Board of Supervisors and the Sonora City Trustees asking for a franchise over the county roads and through this city for an electric street railway to run from Sonora to Jackson.

DENVER, COL.—The Colorado Telephone Company is planning extensive improvements, and the directors have voted to issue $500,000 of treasury stock to pay for the extensions.

FLORENCE, COL.—The Arkansas Valley Electric Company, which was recently awarded a contract to light the town of Rockvale, has begun the work on the system and the town will soon be lighted by electricity.

MERIDEN, CONN.—The Meriden Electric Light Company has petitioned the State Legislature for permission to increase its capital stock from $200,000 to $500,000 and to be allowed to issue bonds to the extent of $250,000.

NORWALK, CONN.—Raymond Brothers are installing a 25-hp electric motor in their coal yard, which will be used for hoisting coal in the future.

NORWICH, CONN.—The Uncas Power Company has applied to the State Legislature for amendments to its charter so that it can furnish electric energy for operating the Westerly electric railway and also to the proposed line to be built from Willimantic to Stafford Springs. The plant is expected to be completed and in operation next fall. The city of Norwich has contracted with the company to supply electricity for operating the municipal electric lighting and power system. Charles W. Comstock is interested in the company.

STAFFORD SPRINGS, CONN.—The Stafford Springs Electric Light & Gas Company is planning to build a large power plant on the Willimantic River in Willington. Land for flowage purposes has already been acquired. The power plant will be constructed and operated by an underlying corporation, the Willington Electric Light & Gas Company, which is now seeking a charter from the Legislature.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until March 19, to furnish aa the navy yards, Charleston, S. C., and Pensacola, Fla., and the naval station, New Orleans, La., a quantity of naval supplies as follows: Schedule 467—Magnet wire, electrical supplies, etc. Bids will also be received until March 26, at the navy yards, New York, N. Y., and Washington, D. C., the naval stations, Key West, Fla., and New Orleans, La., for a quantity of machine tools, etc., as follows: Schedule 469—Electrically driven pump. Schedule 472—Electric traveling crane. Also until March 26, to furnish at the navy yards, Mare Island, Cal., and Puget Sound, Wash., a quantity of naval supplies as follows: Schedule 454—Electrical supplies, etc. Schedule 455—Automatic motor hoists, etc. Schedule 457—Electrical cable and supplies. Applications for proposals should designate the schedules desired by number. E. B. Rogers, Paymaster-General, U. S. N.

ACWORTH, GA.—The new municipal electric lighting plant was put into operation for the first time Feb. 21.

ALBANY, GA.—The City Council has granted a franchise to the Macon, Americus & Albany Railway Company allowing it the use of several streets for a term of 50 years for an electric railway.

AUGUSTA, GA.—T. M. & J. H. Fitzpatrick, of Washington, Ga., is interested in a company which proposes to develop a water power on the Broad River aa Anthony Shoals and to construct a hydro-electric plant of 20,000 hp, an electric railway and to furnish electricity to various cities within a radius of 75 miles. The company is under contract to deliver electric energy in Augusta by July, 1908.

HAWKINSVILLE, GA.—W. N. Parsons, manager of the Hawkinsville cotton mill, writes that the company expects to install a 150-kw, 2,000-volt, 60-cycle alternator in its plant during the summer.

MACON, GA.—Application has been made for a franchise for the Macon, Americus & Albany Electric Railway Company in this city.

ROME, GA.—E. F. Smith, representing the Hiawassee River Power Company, has submitted to the Merchants & Manufacturers' Associaaion, a proposition to furnish electricity in Rome, from the plant near Ducktown, a distance of 75 miles. The company proposes to build a transformer station at Rome, and furnish electric energy to manufacturing plants.

SOCIAL CIRCLE, GA.—Bids will be received until Mar. 18 by W. B. Spearman, Mayor, and the City Council, for $16,000 bonds to be issued for the purpose of erecting an electric light plant.

BOISE, IDAHO.—The Lewiston & Southeastern Electric Railway Company has commenced the work of locating an electric railway between Lewiston and Boise. W. P. Wood, chief engineer of the Lewiston and Southeastern system, states that it is the intention of the company to begin work upon the Lewiston-Boise line immediately. Col. Judson Spofford is general manager.

AMBOY, ILL.—The Amboy Light & Power Company has increased its capital stock from $12,000 to $25,000.

EDWARDSVILLE, ILL.—The McKinley syndicate is considering the rebuilding and increasing the capacity of the tri-city light plant.

FRANKFORT, IND.—At an election recently to vote on the question of giving subsidy of $100,000 for the construction of the power house of the Tipton, Frankfort & Attica Traction line, the proposition was defeated by an overwhelming majority.

INDIANAPOLIS, IND.—The Indianapolis Light & Heat Company has decided to build a new substation on East Olin street, and install a storage battery therein.

INDIANAPOLIS, IND.—A bill has passed the lower house of the Legislature authorizing electric light and power companies to purchase and own or merge with hydraulic companies incorporated in the state. The measure is designed to permit the several electric power plants on the St. Joseph River, near South Bend and Elkhart, to merge with hydraulic plants in the vicinity.

SOUTH BEND, IND.—The officers of the South Bend Electric Company announce that the company will make extensive improvements and changes in the present plant and will install a 1,500-kw turbine and 1,600-hp boilers.

VINCENNES, IND.—The Wabash Home Telephone Company, of Monroe City, Ind., has filed a certificate of increased capital stock from $25,000 to $40,000, and an increase of the directorate from five to seven members.

MONROE CITY, IND.—The Wabash Home Telephone Company has increased its capital stock to $40,000.

ALBIA, IA.—The capitalists who recently purchased the plant and property of the Albia Light & Power Company propose to build a street car line in Albia extending it to Hocking, Hiteman and Buxton, provided the residents take $25,000 worth of stock in the enterprise.

CHARLES CITY, IA.—The City Council has granted an electric light franchise to the Charles City Water Power Company for a period of 25 years, subject to a vote of citizens on March 25.

SIOUX CITY, IA.—The Sioux City Gas & Electric Company has decided to expend about $100,000 in improvements. G. L. Kellogg is general manager.

COLTON, KAN.—A franchise has been granted to A. C. Denman, Jr., for a double track electric railway in this city.

HERINGTON, KAN.—Burns & McDonnell, of Kansas City, Mo., are preparing plans and specifications for water works and an electric light plant, for which the citizens will be asked to vote on April 2 to issue $43,000 bonds for same.

LOUISVILLE, KY.—L. S. Streng, chief engineeer Kentucky Electric Company, writes that bids will be received in about six weeks for the proposed electric power plant.

BATON ROUGE, LA.—The Baton Rouge Electric & Gas Company has been transferred from the John D. Fisher interests to those of the Stone & Webster syndicate, of Boston, Mass. The officers of the new company are: C. D. Wyman, of Boston, Mass., president; A. K. Todd, of Boston, Mass., secretary; A. S. Pratt, of Boston, Mass., treasurer; C. H. Kretz will continue as manager of the plant. The new company contemplates making extensive improvements in the electric plant, the street railway and gas plants.

IOWA, LA.—The Iowa Telephone Company, Ltd., has been formed with J. F. Denison as presidena.

FREDERICK, MD.—The Chesapeake & Potomac Telephone Company has been granted a franchise to place its wires underground on Patrick street. The company will also erect a new exchange building which, with the work of placing its wires underground, will involve an expenditure of between $60,000 and $70,000.

CHICOPEE, MASS.—At the meeting of the Board of Aldermen, held Feb. 15, an order was passed authorizing Mayor Taylor to petition the Legislature for an electric light commission, composed of three members, one to be appointed for one year, one for two years and one for three years.

CHICOPEE, MASS.—The J. Stevens Arms & Tool Company is endeavoring to secure the power rights of the Harris Pond in Ludlow, it is said, with intention of developing it for the manufacture of electricity. The present dam has a capacity of 500 hp, and has a possible development of 800 hp.

CLINTON, MASS.—The Metropolitan Water and Sewerage Board is preparing to utilize the waste water to generate electricity in its power house at the base of the Wachusett dam. A 100-hp turbine is now being installed by the Holyoke Machine Company to operate a generator and motor, which are being placed. The generator will furnish electricity to operate an electric crane which is being placed in the gate chamber to operate the gates. The motor will be used to operate a pump in the power house. When the plant is completed it will also furnish electricity for lighting the building.

WESTFIELD, MASS.—A motor generator has recently been installed in the power plant of the Western Massachusetts Railway Company. The new machine will be used as an auxiliary in case of break down in the plant.

WORCESTER, MASS.—The American Steel & Wire Company is erecting an addition to its power plant. The estimated cost is $5,000.

HOUGHTON, MICH.—The Houghton County Electric Light Company will increase the capacity of its plant during the coming summer by the installation of a 1,000-kw Curtis steam turbo-generator set.

MASON, MICH.—Owing to the inability of the municipal plant to meet the increased demands made upon it, the city officials are negotiating with the Commonwealth Power Company, of Jackson, to furnish electricity for lighting in this city.

NEWAYGO, MICH.—The Portland Cement Company is now installing 150-hp of induction motors in its electric lighting plant. W. J. Bell is superintendent.

NORTHPORT, MICH.—Bids will be received until Mar. 14 for the construction of a water and an electric light plant. The plant will be a 75-hp producer gas outfit with about 2 miles of 3, 4 and 6-inch pipe and 2 miles of wiring. C. B. Kehl is village president.

OWOSSO, MICH.—J. A. Thick, of Detroit, Mich., has offered to purchase the plant and holdings of the Owosso & Corunna Electric Railway, which consist of four miles of road and rolling stock, power house and the equipment for the lighting of the city of Owosso. It is reported that Mr. Thick offered $85,000, but the company wants $100,000.

BEMIDJI, MINN.—The Beltrami Electric Light & Power Company has let a contract for the machinery which will be used in connection with its hydro-electric plant on the Mississippi River, eight miles east of Bemidji. The machinery will consist of a large water wheel, wiring and all other equipment for the plant. The capacity of the plant is estimated at 25,000 hp. The company will erect a transmission line to this city, a distance of eight miles. The work of building the dam will be commenced just as soon as the plans are completed and the necessary material can be secured.

WEST CONCORD, MINN.—The question of constructing an electric light or gas plant is under consideration.

WINONA, MINN.—The Winona Water, Sewerage, Ice & Light Company is contemplating installing a 200-hp water heater in its plant. J. F. Miller is manager.

CLINTON, MISS.—The citizens have voted to issue $3,000 in bonds, to purchase an engine, boiler and other necessary equipment to be installed in municipal light and water works.

POPLARVILLE, MISS.—The contract for erecting the power house to be used jointly for the water works and electric light plant has been awarded to W. P. Craft, of Ellisville.

OXFORD, MISS.—A 200-kw, three-phase, 1,100-volt, 60-cycle generator will soon be installed in the University Light plant. J. R. Shinault is general manager.

TUPELO, MISS.—An additional 150-hp boiler will be installed in the municipal electric light and water plant during the year. W. H. St. John is superintendent.

YAZOO, MISS.—Plans and specifications are being prepared by Kirkpatrick & Johnson, of Jackson, Miss., for an electric railway to be built by the city of Yazoo. Work will commence on the construction of the line at once.

ELDORADO SPRINGS, MO.—F. W. Hiatt, manager of the Eldorado Springs Electric Company, writes that the company may possibly change its alternating-current dynamo and engine and also install one boiler.

BLOOMFIELD, MO.—The Bloomfield Electric Light & Power Company is contemplating installing a water works plant and a hot water system. B. F. Eicholtz is manager.

BOLIVAR, MO.—W. H. Maas, superintendent of the Bolivar electric light and water plant, writes that it is planned to increase the boiler capacity to 170 hp, and install a 150-hp engine and a dynamo of 80 kw capacity in the plant by April 1.

CENTRALIA, MO.—The citizens voted Feb. 26 to issue $55,000 in bonds for water works and an electric light plant. Burns & McDonnell, of Kansas City, Mo., are the engineers.

CHILLICOTHE, MO.—It is reported that William Lawler of Fremont, Neb., is negotiating for the purchase of the plant and holdings of the Peoples Gas & Electric Company.

HEBRON, MO.—The Farmers' New Era Telephone Company has decided to increase its capital stock from $50,000 to $100,000.

JOPLIN, MO.—The Missouri Lead & Zinc Company is contemplating extensive improvements to its plant, involving an expenditure of $25,000, among which is an addition to its power house.

LOUISIANA, MO.—The Louisiana Gas & Electric Light Company is planning to double the capacity of its plant and change the system to two-phase, 60-cycles, 2,300-volt within 90 days. D. Turnboldt is manager.

NEVADA, MO.—M. P. Murray, of St. Louis, has been appointed receiver of the property of the Missouri Water, Light & Traction Company by the Circuit Court. The property includes water works, light plant and street railway system. The city was threatening to take charge of the properties when the bondholders of the company stepped in and asked for the receivership. The Missouri Lincoln Trust Company, of St. Louis, holds bonds of the company amounting, with interest, to $245,000. The trust company promises to repair the various plants and put them in condition to give good service.

OREGON, MO.—Extensions and improvements are now being considered for the municipal electric light and water plant. The capacity of the plant is to be increased to 120 kw with either crude oil or gas producer outfit. A storage battery will also be installed. M. R. Martin is manager.

RICHMOND, MO.—The Richmond Electric Light Company is preparing to discard its T. H. arc machine and is installing a 120-kw alternator and an alternating-current series arc system to take the place of old open arc series street lamps. J. M. Ferguson is manager.

ST. CHARLES, MO.—The St. Charles Electric Light & Power Company is contemplating the installation of another 200-kw direct-connected unit in its plant and line extensions. Charles L. Pierson is manager.

SLATER, MO.—The citizens are contemplating the installation of a series alternating-current enclosed arc street lighting system in connection with the municipal lighting plant. Address L. E. Shepherd.

BIG TIMBER, MONT.—Extensive improvements and additions are contemplated by the Big Timber Light & Power Company. A Westinghouse generator of 60 kw capacity and a 90-kw dynamo will be installed; two boilers will also be placed in the plant. J. R. Kaiserman is manager.

BUTTE, MONT.—F. Augustus Heinze has petitioned the Council for an electric lighting franchise.

LIVINGSTON, MONT.—The New World Smelting Company is contemplating the construction of an electric railway to Cooke.

MISSOULA, MONT.—A new 4,000-hp water power plant is now being constructed by the Missoula Light & Water Company. A. H. Wethey.

GOLDFIELD, NEV.—Because of the large increase in the demand for electric power throughout the mining camps in Southern Nevada, a combination of interests has been effected, whereby the Nevada Power Mining & Milling Co. will reincorporate as the Nevada-California Power Company and will acquire additional lands and water rights and issue bonds and new stock. The present power plant of the company is at Bishop Creek in California, which is being largely increased in capacity. Two new lines are now being built, one to Rhyolite and the other to Bullfrog, and still another will be constructed to Lida.

RENO, NEV.—A company, said to be composed of San Francisco and Nevada capitalists, is building a large power plant on the west branch of the Carson River near Woodfords, Cal. The company has purchased all of the lower end of Hope Valley, and is now build-

ing a dam across the mouth of the narrow valley for reservoir purposes. The plant will have a capacity of 8,000 horsepower, and will furnish electricity for light and power in Reno, Virginia City and Carson City. This company will compete with the Fleishhacker interests which now control the four water power plants in this portion of Nevada.

VIRGINIA CITY, NEV.—Frank Leonard, Jr., of the Sutro Tunnel Company of this city, has recently installed electric cars in the Sutro tunnel to take the place of the old mule cars, which have been used in the tunnel since it was constructed during the early days of the Comstock. Mr. Leonard states that he intends to equip all the tunnels on the Comstock with electric instead of mule cars.

CLAREMONT, N. H.—The Claremont Railway & Lighting Company has published a petition for a location and a franchise to construct and operate a street railway between West Claremont and Claremont Junction, connecting with the company's lines at these points and completing a belt line.

PORTSMOUTH, N. H.—Bids will be received until Mar. 30 by H. H. Rousseau, chief of bureau of yards and docks, Navy Department, Washington, D. C., for a 1,000-w generating set and accessories for the navy yard, Portsmouth. Estimated cost, $45,000, as per specification 1530.

ATLANTIC CITY, N. J.—The City Council on Feb. 26 employed Carrere & Hastings, of New York, N. Y., architects, to outline a scheme of civic improvement along city beautiful lines, to cost, it is estimated, about $500,000. Ornamental lagoons on the meadows, and a boulevard near the beach, together with an elaborate system of illumination, and preliminary steps in a scheme to eventually make the Boardwalk a concrete esplanade will be included in the changes contemplated. The architects' plan is to be submitted in about three months.

CAMDEN, N. J.—We are informed that agitation still continues for a municipal lighting plant. Preliminary report estimates the cost at $200,000 for 600 arc lamps with part underground system. The contract now in force for lighting runs three years yet. L. E. Farnham is city engineer.

BINGHAMTON, N. Y.—The Binghamton Light, Heat & Power Company has placed contracts for equipment for its plant which will increase the capacity of the station on Court street by 1,000 hp. The contract calls for one engine, steam turbine, of 1,000 hp, with two boilers, with equipment of pumps, fittings, etc.

COXSACKIE, N. Y.—The Catskill Illuminating & Power Company, the Schoharie Light & Power Company and the Cairo Electric Light & Power Company have been consolidated. The new company will be known as the Greene County Light & Power Company.

ALBANY, N. Y.—A bill has been introduced by Senator O'Neil and Assemblyman Merritt, of St. Lawrence, in the State Legislature, asking for the incorporation of the Long Sault Development Company and authorizing it to construct and maintain dams, canals, power houses and locks at or near Long Sault Island for the purpose of improving navigation of the St. Lawrence River and development of power, and to construct and maintain a bridge and carry on the manufacture of commodities with such power. In consideration for these rights the corporation agrees to construct and provide electrical energy for the use of such locks as may be required by the United States government.

GLENS FALLS, N. Y.—The Hudson Valley Railway Company is contemplating extending its line during the year connecting Warrensburgh and Thurman. Edgar S. Fassett is general manager.

HOOSICK FALLS, N. Y.—The Hoosick Falls Illuminating Company has submitted a proposition to the Board of Village Trustees in which, for a five-year contract, they agreed to furnish arc lamps for $65 for each lamp per year and 32-cp incandescent lamps for $20 each per year, a reduction of $12.50 each for arc lamps and $4 each for the incandescent lamps, as compared with the last contract. From figures presented the trustees think a more favorable contract should be secured. The light committee was authorized to enter into a contract with the Illuminating Company for arc lamps at a price not to exceed $60 per year.

MEDINA, N. Y.—The A. L. Swett Light & Power Company is planning to extend its line east and north. A. J. Howard is manager.

OSWEGO, N. Y.—The National Starch Company is contemplating the erection of a large power house near the present power house.

SYRACUSE, N. Y.—Clifford D. Beebe, acting for a Syracuse syndicate, has purchased the Syracuse & South Bay Railway property at a mortgage foreclosure sale for $251,000. The new owners will push the road to completion and it is expected to have the road in operation some time during the coming summer.

UTICA, N. Y.—The stockholders of the Utica Home Telephone Company have voted to increase the capital stock of the company from $500,000 to $1,000,000.

MARION, N. C.—J. L. Morgan, manager of the Marion Light & Power Company, writes that the company expects to develop 300 hp on the Catawba River to furnish electricity for lighting and power purposes.

MURPHY, N. C.—The Murphy Light & Power Company is contemplating extending its lines one mile.

NEWTON, N. C.—The citizens are now considering the installation of an entire new electric lighting plant of larger capacity during the present year. W. B. Gaither is manager.

STATESVILLE, N. C.—A new sub-station will be installed in connection with the municipal electric light plant within a few months. Three 500-kw transformers have been purchased for this station; the other equipment has not yet been bought.

WELDON, N. C.—The Roanoke Navigation & Water Power Company will soon install two Westinghouse dynamos of 200 and 300 kw. W. W. Wiggins is superintendent.

LEEDS, N. D.—The Leeds Electric Light & Power Company is contemplating the installation of a public steam heating system in its plant. C. G. Candee is manager.

AKRON, OHIO.—The Thomas H. Brooke Company, of Pittsburg, has made application for a 25-year franchise to operate an electric light plant in this city and has secured an option on the old Cascade mill property.

ARCADIA, OHIO.—The installation of an electric storage battery is contemplated in the Arcadia electric light plant of which P. A. Whiland is owner.

ARLINGTON, OHIO.—The citizens have purchased the electric light plant here, and will improve the same.

CINCINNATI, OHIO.—The Union Gas & Electric Company has established an electric kitchen in its sales rooms at Fourth and Race streets, which is equipped with every utensil used in the modern kitchen for the purpose of demonstrating the various methods of cooking by electricity.

CLEVELAND, OHIO.—Bids will be received until Mar. 27 by the Board of County Commissioners (Julius C. Dorn, clerk) for furnishing electricity for arc and incandescent lamps and electric fans and for such other purposes as may be required in the county buildings, commonly known as the old court house, new court house, county jail and county morgue, for a period of one year from the date of entering into contract.

COLUMBUS, OHIO.—A large power plant is being erected by the Columbus & Hocking Coal & Iron Company at Kathelmacher, near Straitsville.

COLUMBUS, OHIO.—The Directors of the Public Service have instructed the secretary of the board to advertise for bids for the additional machinery for the municipal electric light plant, which will be opened March 28.

COLUMBUS, OHIO.—The Columbus Public Service Company will accept the new rate for electricity fixed by the City Council. The Public Service Company, it is stated, is ready to extend its line if a rate averaging 5 cents per kw-hour can be secured.

COLUMBUS, OHIO.—The Columbus Power Company has offered to furnish the new industrial school with electric energy for the operation of its machinery for a period of five years free of charge. The company offers to furnish 75 hp, which would cost $2,000 per year, making a donation of $10,000.

GALLIPOLIS, OHIO.—The Hoke Telephone Company has increased its capital stock from $20,000 to $30,000.

LAKEWOOD, OHIO.—Bids will be received until Mar. 13 by B. M. Cook, village clerk, for furnishing, lighting, extinguishing and keeping in repair, including the furnishing of electricity and all materials therefor; 180 or more 450-watt electric arc lamps upon (1) an all-night and every-night schedule and (2) upon a moonlight schedule, for a period of 10 years after Mar. 1, 1907.

MINERVA, OHIO.—A new outfit of engines and dynamos for the municipal electric light plant is now under consideration. A. A. Bates is superintendent.

NEW LEXINGTON, OHIO.—The Citizens Independent Telephone Company has increased its capital stock from $50,000 to $100,000.

PAULDING, OHIO.—The Board of Public Service is advertising for bids for the construction of a new electric light plant, to be installed in connection with the water works plant.

WESTERVILLE, OHIO.—Bids will be received by the village clerk until March 26 for the purchase of $3,000 bonds, issued for the purpose of extending and improving the municipal electric light plant. C. P. Sprague is village clerk.

CAPITOL HILL, OKLA.—H. B. Hamlin and C. M. Baker have petitioned for a franchise for an electric light plant.

GUTHRIE, OKLA.—The Pioneer Telephone Company is making arrangements to improve the local service. The company has appropriated $100,000 to extend its lines and install additional equipment.

SNYDER, OKLA.—The citizens on Feb. 26 voted to issue $30,000 bonds for water works, electric light plant and sanitary sewers, and bids for constructing the same will be received on Mar. 20. Dr. J. R. Bryce is Mayor. For plans, address W. P. Bullock, engineer, Kansas City, Mo.

KLAMATH FALLS, ORE.—C. S. and R. S. Moore are promoting a large power plant for Klamath Falls, which is to be in operation within one year. The Moore Brothers have secured 7,000 miners' inches of water from the Kenlo Canal. Electricity will be furnished for lighting purposes, operating saw mills, flour mills and other manufacturing plants,

and will also supply electric energy for the electric railway which is now under construction.

MEDFORD, ORE.—Messrs. Blakely and Welch, of the Sterling Mining Company, have asked the City Council for a franchise for an electric railway to be built from Medford to Jacksonville. They also want to take over the electric light plant and water works systems, which are now operated by the city at a loss and operate them as a private enterprise.

PANAMA.—Bids will be received until Mar. 12 by the Isthmian Canal Commission, D. W. Ross, purchasing agent, Washington, D. C., for electrical supplies, machines for machine shops, etc.

LEWISBURG, PA.—The Lewisburg Light, Heat & Power Company has been awarded a contract for lighting the streets of the borough of Lewisburg for a term of three years. By the terms of the contract the company is to furnish arc lamps at $71.50 per lamp per year and incandescents at $14.50 per lamp per year.

NEW CASTLE, PA.—C. F. Newton and A. W. Lyde are preparing to erect a plant here for the manufacture of electric drills. It is said the plant will employ about 110 skilled men. Both Messrs. Newton and Lyde are Pittsburg men.

POTTSTOWN, PA.—Plans have been completed by the Schuylkill Valley Traction Company for the extension of its line from Ringing Rocks Park to Boyertown, the building of which will complete its electric railway system between Philadelphia and Reading.

PRICEBURG, PA.—The Priceburg Light Company has purchased property here, to be used as a site for lighting plant.

SHENANDOAH, PA.—Work has commenced by the Reading Company on an electric plant at the West Shenandoah Colliery to supply electricity for the movement of coal wagons in the upper tunnel of the Turkey Run mine. Eventually all the colleries will be supplied with electric energy.

SOUTH SHARON, PA.—The citizens are considering the question of issuing $50,000 in bonds for a municipal electric light and an election will be held March 26 to vote on the proposition.

STROUDSBURG, PA.—Plans are being made for the construction of an electric railway between Philadelphia and Delaware Water Gap. The new road will extend from Wind Gap to Saylorsburg and thence to the electric line now being constructed by Wilkesbarre capitalists to East Stroudsburg and the Gap. It is to be known as the Stroudsburg & Wind Gap Street Railway Company, of which J. B. Williams, of Stroudsburg, is president. A power plant will be located at Pen Argyl.

YORK, PA.—The York County Traction Company has commenced to make a preliminary survey for a proposed electric railway between Hanover and New Oxford.

CEBU, P. I.—The Visayan Electric Company is contemplating the installation of a 300-kw alternating-current generator and another boiler. The plant is under the management of the Bryan Landon Company.

SAN JUAN, P. R.—The San Juan Light & Transit Company is constructing a hydro-electric plant with a transmission line 22 miles in length. Will also build a sub-station complete and lighting circuits will be entirely overhauled and rebuilt. C. F. Beams is manager.

PROVIDENCE, R. I.—The Vanity Fair Company has entered into a contract with the Narragansett Electric Company for the installation of an electrical plant at "Vanity Fair," a summer resort under construction in this city, at a cost of $75,000. The lighting company agrees to furnish electricity at a pressure of 10,000 volts, building for that purpose a fire-proof transforming station, and installing the machinery for the plant. The plant will provide for not less than 125,000 incandescent lamps.

CHARLESTON, S. C.—The Calhoun Falls Power Company was organized on Feb. 18, with Patrick Calhoun, president, and H. F. Gans, secretary, to develop the water power at Trotter Shoals on Savannah River in Abbeville County, S. C., and Elbert County, Ga.; it is estimated that the falls are capable of developing 27,000 hp.

WOODRUFF, S. C.—A. B. Groce, of Wellford, S. C., writes that it is proposed to develop Patton Shoals for electrical purposes, at a cost of $25,000 to $50,000.

NASHVILLE, TENN.—The City Council has passed on first reading the ordinance appropriating $6,000 for new arc light equipment and $7,000 for wire, poles and cross arms for the lighting department.

DALLAS, TEX.—The American Engineering Company, of Indianapolis, Ind., has secured the contract for the engineering work for building 26 miles of electric road in this city and also has the contract for the electric railway to be built from Greenville to Dallas (47 miles of line), for the Dallas Interurban Electric Company.

GAINESVILLE, TEX.—The Merchants' Electric Light & Power Company has filed an amendment to its charter increasing its capital stock from $25,000 to $50,000.

GALVESTON, TEX.—The Stone & Webster interests, of Boston, Mass., have closed a deal for the construction of an electric interurban road connecting Galveston and Houston, a distance of 50 miles; for building twenty miles of side lines to towns on Galveston Bay in Texas, and also for a 75-mile electric road between New Orleans and Baton Rouge, the syndicate having purchased the Baton Rouge street railway system.

PLAINVIEW, TEX.—A company has been formed for the purpose of installing an electric light plant.

SEGUIN, TEX.—W. R. Campbell, who recently purchased the Seguin Street Railway Company's system, will take charge of the plant at once. Many important improvements are contemplated.

CASTLEDALE, UTAH.—The C. L. Allen & Company, which operate the local electric light plant, has secured a franchise from the town of Ferron for an electric light system in that place. The company has also received a franchise from the county to erect its lines throughout the county. Franchises have also been granted to the company in the towns of Huntington, Grangeville and Castledale.

GREEN RIVER, UTAH.—The Green River Light & Power Company has applied to the Town Board for a franchise for an electric light plant and a street railway system. The electric lighting system is to be installed and in operation within one year, and the electric railway will be in operation within two years. Howard H. Merritt is secretary.

OGDEN, UTAH.—Plans are now being made by the Utah Light & Railway Company for the construction of a new sub-station in this city at a cost of more than $10,000.

ST. JOHNSBURY, VT.—The Village Trustees have made a contract with the St. Johnsbury Electrical Company to light the streets of the village for a term of five years. By the terms of the contract the company is to furnish arc lamps of 2,000 cp at the rate of $60 per lamp per year. This is $4.30 per lamp less than the previous cotnract, and on the new contract the village will save about $400 a year.

ALEXANDRIA, VA.—The Washington, Alexandria & Mount Vernon Electric Railway Company has submitted a proposition to the City Council for a franchise to extend its lines on several streets of the city. The company offers to pay $150 annually for the franchise and to grant to the city all right and title to the property recently acquired, subject to the right of the company to occupy it with its tracks.

FRANKLIN CITY, VA.—Arthur L. Osgood, The Bourse, Philadelphia, Pa., is contemplating the construction of an electric light plant and also water works system.

ROSLYN, WASH.—The Northwestern Improvement Company is contemplating installing two 300-kw direct-current units and an alternating-current unit of 500 kw in its plant.

TACOMA, WASH.—Announcement has been made of the dissolution of the firm of Davis Brothers Electric Company. The firm has been absorbed by a new corporation known as the Davies Electric Corporation with a paid capital stock of $150,000.

ROWLESBURG, W. VA.—H. R. Hollis, City Recorder, writes that bonds for the proposed electric light plant, to the amount of $12,000, have been sold.

ASHLAND, WIS.—At a recent meeting of the City Council it was decided to have plans made at once and call for bids for the municipal lighting plant.

CLEAR LAKE, WIS.—A telephone company has recently been organized here with a capital stock of $5,000.

CUBA CITY, WIS.—The contract for the erection and installation of the new plant for the Cuba City Power, Electric & Pumping Company has been awarded to the Galena Iron Works for $5,150.

KNAPP, WIS.—The Knapp Telephone Company has filed amendments to its charter increasing the capital stock from $5,000 to $15,000.

KAUKAUNA, WIS.—L. C. Wolf, city clerk, writes that there is some talk here of installing an electric light plant. For further information address Julius J. Martens, of South Kaukauna.

MILWAUKEE, WIS.—Surveys are being made for the Milwaukee & Northern Electric Railway from Milwaukee to Fond du Lac via Cedarburg; also from Cedarburg to Port Washington. J. M. Seamann, of Sheyboygan is manager.

PORTAGE, WIS.—The Central Wisconsin Telephone Company has filed an amendment to its charter changing its name to the Central Wisconsin Long Distance Telephone Company.

VANCOUVER, B. C.—The British Columbia Electric Railway Company will soon place contracts for the first part of the new electrical equipment for the new plant which the company is to install at Lake Buntzen. The present capacity of the plant is 12,000 hp, which will be increased by three units of 10,000 hp each. The cost of improvements to the plant is estimated at $250,000.

BATTLEFORD, CAN.—The City Secretary writes that it is proposed to install water works, a sewerage system and an electric light plant this summer, and bids will soon be called for.

INDIAN HEAD, CAN.—The city will spend $25,000 this year in extensions to the electric lighting plant. Address T. E. Donnelley, mayor.

CARMAN, MAN.—The managers of the municipal electric light plant are contemplating installing an arc lighting system for lighting the streets, and rebuilding lines in the spring. H. E. Rolinson is manager.

MINNEDOSA, MAN.—The town has decided to develop the water power in the Little Saskatchewan River here. Address E. O. Dennison.

WINNIPEG, MAN.—Sealed tenders will be received by Magnus Peterson, secretary of the Board of Control, until March 13 for the supply of 200 arc lamps with two regulators and necessary panels; also 12 lightning arresters. Specifications may be seen in the office of F. A. Cambridge, city electrician.

CAMPBELLFORD, ONT.—The citizens are contemplating the construction of a new municipal electric lighting plant in the near future. F. J. Smith is manager.

TORONTO, ONT.—Application is being made to the Provincial Government for a charter to build and operate an elevated electric street railway in Toronto. J. M. Sinclair, S. R. Wickett and J. H. McKnight are interested.

Company Elections.

HARDFORD, CONN.—The directors of the Hartford Electric Light Company have re-elected officers as follows: Austin C. Dunham, president; D. Newton Barney, treasurer; Curtis C. Cook, secretary; R. W. Rollins, general manager; E. F. Lawton, superintendent; W. L. Robb, consulting engineer.

ONTARIO, ILL.—At the annual meeting of the Oneida & Ontario Telephone Company held recently the following officers were elected for the ensuing year: O. L. Fay, president; H. W. Crane, vice-president; W. E. Duma, treasurer; Carl Crane, secretary.

ANDERSON, IND.—The directors of the Delaware & Madison County Telephone Company at the annual meeting held Feb. 18, elected the following officers: George W. Beers, of Muncie, president; W. H. H. Quick, Anderson, vice-president; Wm. Rose, Muncie, secretary; William Hitchcock, Muncie, treasurer.

ST. LOUIS, MO.—At the annual meeting of the directors of the Kinloch Long-Distance Telephone Company, held receently, the following officers were re-elected: William D. Orthwein, president C. Marquard Forster, first vice-president Breckenridge Jones, second vice-president H. G. Fadeley, treasurer H. Linton Reber, secretary and general manager; James Harrison, chief engineer.

ST. LOUIS, MO.—At the annual meeting of the directors of the Bell Telephone Company the present officers were elected as follows: C. P. Walbridge, president; Edward Whittaker, vice-president; Fritz Nisbet, secretary and treasurer; James K. Wass, auditor; F. R. Mott, general superintendent; George F. Durant, general manager.

ALBANY, N. Y.—At the annual meeting of the stockholders of the Hudson River Telephone Company held Feb. 26, the election of Samuel M. Greer to take the place of George P. Ide, of this city, is the only change. The directors are: John E. Adriance, Poughkeepsie; Union N. Bethell, New York; Charles F. Cutler, New York; Frederick P. Fish, Boston; D. Cady Herrick, Albany; Walter C. Humstone, Brooklyn; James H. Manning, Albany; Samuel M. Greer, Brooklyn; Hiram F. Stevens, Syracuse. Inspectors of election: James J. Fitzsimmons, Walter B. Butler and George C. Van Tuyl, Jr., all of Albany.

UTICA, N. Y.—The annual meeting of the Central New York Telephone & Telegraph Company, held Feb. 26, the directors elected the following officers: U. N. Bethell, of New York, president; H. F. Stevens, of Syracuse, vice-president; F. G. Wood, of Utica, secretary and treasurer; W. W. Nicholson, general manager; B. C. Wolverton, chief engineer, and A. W. Deas, auditor.

FREMONT, OHIO.—At a meeting of the directors of the Fremont Home Telephone Company held recently Russ J. Christy was chosen as president to succeed the late Judge Brinkerhof. The other officers are as follows: James G. Hunt, vice-president; John M. Sherman, treasurer; George Seaman, secretary and general manager.

NEW PHILADELPHIA, OHIO.—At the annual meeting of the directors of the Tuscarawas County Telephone Company, the officers were re-elected as follows: Charles H. Slingluff, president; J. K. Johnston, vice-president; John L. Kennedy, treasurer; Edgar A. Walter, secretary; J. K. Johnston, general manager, and W. B. Gregson, auditor.

PHILADELPHIA, PA.—At the annual meeting of the Bell Telephone Company held Feb. 19, the stockholders re-elected the present board of directors, with the exception of E. T. Meany, who was succeeded by H. A. Richardson, of Dover, who founded the Diamond State Telephone Company, recently absorbed by the Bell Company. President Bethel stated at the meeting that $3,600,000 had been appropriated by the directors for extensions and improvements during the year 1907.

PITTSBURG, PA.—At the annual meeting of the Central District & Printing Telegraph Company held Feb. 14, the following officers were elected for the ensuing year: D. Leet Wilson, president; D. F. Henry, vice-president; J. G. Stokes, secretary; F. M. Stephenson, treasurer; M. H. Buehler, general manager.

NASHVILLE, TENN.—At the annual meeting of the stockholders of the Nashville Railway & Light Company, held recently, the following officers were elected for the ensuing year: Percy Warner, president; J. C. Bradford, vice-president; H. C. Walters, secretary and treasurer. The directors are: Percy Warner, A. M. Shook, J. C. Bradford, Joseph H. Thompson, F. O. Watts and V. E. Shawb, of Nashville; J. K. Newman, S. H. March and George H. Davis, of New York, N. Y.

New Industrial Companies.

THE AMERICAN ELECTRICAL ENGINEERING COMPANY, of Rock Island, Ill., has been incorporated with a capital stock of $2,000 by Harry H. Unverforth and others.

THE AMERICAN ELECTRIC FURNACE TRUST, of North Adams, Mass., has been organized by James W. Hoitt, Trueman P. Sharts, Hiram E. Taylor, Henry C. Bliss, Charles J. Howe and Enoch H. Beer, all of North Adams, Mass. It is the purpose of the trustees of the concern to build a plant for the treatment of ores, and later to build electric furnaces for sale or lease.

THE AMERICAN PAY SIGNAL COMPANY, of Waterbury, Conn., has been incorporated with a capital stock of $12,000 by Lucien F. Burpee, Terrance F. Carmody and Walter E. Monagan. The company proposes to manufacture electrical equipments.

THE AUTOMATIC ELECTRIC SIGNAL COMPANY, of Milwaukee, Wis., with a capital stock of $25,000, has been incorporated by George L. Balgauf, John J. Krohn and others.

THE BALLARD ELECTRICAL CONSTRUCTION COMPANY, of Ballard, Wash., has been incorporated with a capital stock of $2,000 by F. F. Fisher and others.

THE CAPITAL CONTRACTING COMPANY, of Toledo, Ohio, has been incorporated with a capital stock of $30,000 by Clement Carpenter and others. The company proposes to do a contracting business and build telephone plants in the Middle West.

THE COLUMBUS ELECTRICAL WORKS COMPANY, of Columbus, Ohio, has been incorporated with a capital stock of $25,000 by O. M. Spielman, C. Edward Spielman and others.

THE KNIGHT LIGHT COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $15,000, for the purpose of manufacturing and dealing in light fixtures. The incorporators are Frederick Z. Marx, Joseph H. Mahoney and James S. Knight.

THE CRAIGHEAD ELECTRIC COMPANY, of Richmond, Ind., has filed articles of incorporation with the Secretary of State. The company intends to carry on a general electrical contracting business, and make a specialty of installing electric lighting plants, also steam and water heating plants. Edward W. Craighead is president.

THE MONOLITHIC DUCT COMPANY, of New York, N. Y., has been incorporated with a capital stock of $10,000. The directors are C. T. Hutchinson, J. M. Boyle and H. H. Porter, of New York, N. Y.

THE QUEENETTE MANUFACTURING COMPANY, of New York, N. Y., has been incorporated with a capital stock of $25,000, for the purpose of manufacturing mechanical and electric appliances. The directors are: William Knobloch, New York, N. Y.; J. N. Hyams and A. G. Meyer, New York, N. Y.

THE ROBERTS & MYERS COMPANY, of Walden, N. Y., has been incorporated with a capital stock of $1,000 by C. F. McGilvray, H. E. Myers, of Springfield, Ohio; W. J. Smith, New York.

THE WARNER ELECTRIC COMPANY, of Cleveland, Ohio, has been incorporated with a capital stock of $15,000 by E. L. Warsaw, F. J. Bailey and others.

THE WESTERN WIRE SALES COMPANY, of Chicago, Ill., has filed articles of incorporation with a capital stock of $5,000. The company proposes to manufacture and deal in electrical machinery.

THE WESTERN ELECTRIC SUPPLY COMPANY, of El Paso, Tex., has been chartered with $100,000 capital stock by J. M. Power and others.

New Incorporations.

LOS ANGELES, CAL.—Articles of incorporation have been filed for the Union Home Telephone & Telegraph Corporation with a capital stock of $10,000,000 by John C. Marble and others.

LOS ANGELES, CAL.—Articles of incorporation have been filed for the Red Cross Electric Company with a capital stock of $25,000. The directors are H. E. Yockey and others.

LOS ANGELES, CAL.—Articles of incorporation have been filed for the California Nevada Electric Power Company with a capital stock of $10,000 by R. E. Maynard and others.

SAN FRANCISCO, CAL.—The Green Creek Electric Power & Water Co. has been incorporated with a capital stock of $5,000 by G. E. Weaver, J. G. Weir and E. T. Zook. Place of business, San Francisco.

SAN FRANCISCO, CAL.—Articles of incorporation have been filed for the San Francisco, Alameda & Eastern Railway Company with a capital stock of $2,000,000 by A. D. Schindler, A. H. McHuron, W. H. Spaulding and L. Q. Haven. F. M. Greenwood was elected treasurer of the company.

SANTA CRUZ, CAL.—The Ocean Shore & Eastern Railway Company has been incorporated with a capital stock of $3,000,000 to build an extension of the Ocean Shore line from Santa Cruz to Watsonville, a distance of 20 miles. The incorporators are J. Downey Harvey, J. A. Folger, Woodside; Charles Carpy and Charles C. Moore.

CANON CITY, COL.—Articles of incorporation have been filed for the Canon City Royal Gorge & Electric Railway Company by James J. Peabody and others. The company is capitalized at $1,250,000.

HARTFORD, CONN.—The Bolivia Railway Company of Hartford has filed a certificate of incorporation and taken out an omnibus charter. The concern, which has an authorized capital stock of $10,000,00, proposes to construct and operate railways and other public utilities in South America. The incorporators are Edward W. Burdick, of Englewood, N. J.; Aloysius C. Gahan, Arthur Starke and Frank L. Sullivan, of New York City, and Jacob G. Metcalfe, of Lakewood, N. J. Mr. Metcalfe has been elected president, Mr. Burdick, vice-president, and H. Starr Giddings, of New York, secretary and treasurer.

HARTFORD, CONN.—Articles of incorporation have been filed with the Secretary of State for the Susquehanna Railway, Light & Power Company by Lucius F. Robinson, John T. Robinson and Albion B. Wilson, all of Hartford. The company is capitalized at $20,000,000.

CHICAGO, ILL.—The Tri-State Light & Power Company has been incorporated with a capital stock of $1,000 by C. H. Poppenhusen and others.

FREEPORT, ILL.—The Northwestern Telephone & Telegraph Company has filed articles of incorporation with a capital stock of $30,000. The incorporators are C. B. Cheadle, of Joliet, Frank Zinnel, of Savanna, and L. A. Herrick, of Freeport.

GILLESPIE, ILL.—The Gillespie Telephone Company has been incorporated with a capital stock of $25,000 by J. A. Stice, R. H. Isaac and T. H. Hall.

MASCOUTA, ILL.—The Southern Illinois Long Distance Telephone Company has filed articles of incorporation with the Secretary of State with a capital stock of $2,500. The incorporators are G. F. Wembacher, H. V. Leitig and C. R. Harris.

BROWN'S VALLEY, IND.—Articles of incorporation have been filed for the Brown's Valley Telephone Company, with a capital stock of $500. The directors are H. Bayless and others.

GREENFIELD, IND.—The Shilo Telephone Company has incorporated. N. T. Foster, O. F. Addison and George Hargraves are the directors.

MUSKOGEE, I. T.—Articles of incorporation have been filed for the Oklahoma State & Telephone Company by Guy T. Berry and others. The capital stock of the company is $100,000.

SHILOH, IND.—The Shiloh Telephone Company has been incorporated with a capital stock of $140 by J. M. Hurd and others.

CARROLL, IA.—Articles of incorporation have been filed for the Central Iowa Illuminating & Power Company by Henry Ricke, of Cedar Rapids; G. M. Stanton and W. C. Saul, of Carroll.

CLINTON, IA.—The Rock Island Company has been incorporated for the purpose of constructing the proposed interurban line from Monmouth or Galesburg to Rock Island. The company has a capital stock of $500,000, and the officers are G. H. Higbee, of Burlington, president; E. C. Walsh, vice-president; C. H. Walsh, of Burlington, secretary, and J. W. Walsh, treasurer.

MARSHALLTOWN, IA.—Articles of incorporation have been filed for the Iowa Illuminating & Power Company by Henry Rickel and others. The company has a capital stock of $200,000.

IOWA, LA.—The Iowa Telephone Company, Limited, has been organized by the farmers and citizens of Iowa. J. F. Denizen was elected president.

PORTLAND, ME.—Articles of incorporation have been filed for the Idaho-Oregon Light & Power Company, with a capital stock of $7,000,000, to build and operate light, heat and power plants. The officers are: J. E. Manter, president; C. E. Eaton, treasurer, and M. W. Baldwin, all of Portland.

MERRIMAC, MASS.—The Merrimac Valley Electric Company, a holding company, has recently been organized to control and operate the Citizens' Electric Street Railway Company, the Haverhill & Amesbury Street Railway Company, the Salisbury Land & Improvement Company and the Salisbury Beach Improvement Company. James F. Shaw is president and George A. Butman treasurer of the new company.

DETROIT, MICH.—Incorporation papers for the Interstate Long Distance Telephone Company, with a capitalization of $15,000,000, have been filed with the Secretary of State. The new company will have central offices in Detroit. It is organized for the purpose of building a long distance telephone system throughout Michigan, connecting with the various independent systems of Michigan, Ohio and points east and west.

LESLIE, MICH.—The North River & Leslie Telephone Company has been incorporated with a capital stock of $400.

WINONA, MINN.—The La Crosse & Winona Traction Company has filed articles of incorporation with the Secretary of State with C. M. Morse as president, and Stephen H. Somsen, secretary. This company has been formed in connection with the development of a light and power plant on the Black River. The company will ask for a franchise to furnish electricity for lighting and power in Winona, and will also construct and operate an electric railway between Winona, Galesville and La Crosse.

DELL, MONT.—The Dell Telephone Company has filed articles of incorporation with the Secretary of State with a capital stock of $10,000. The directors are: H. Clay Patterson, Frank Nelson, Harry Andrews, Henry Thompson, Walter Crowell, Edgar Kennison, E. M. Martinell, of Dell, and O. C. Gossman and Robert Schendell, of Lima.

HELENA, MONT.—A company will soon be formed under the name of the Helena & Butte Electric Railway Company to build an electric railway between Helena and Butte. The capital stock of the company will be placed at $250,000. F. Augustus Heinze has agreed to subscribe for $125,000 of the preliminary stock, the balance being taken by the citizens of Helena and Butte.

WILDWOOD, N. J.—Articles of incorporation have been filed for the Wildwood Electric & Traction Company, with a capital stock of $1,000,000. The company proposes to do a general investment business. The incorporators are W. J. Classon, F. C. Meeteer and A. J. Beckenbach.

CROGHAN, N. Y.—Articles of incorporation have been filed for the Beaver River Light & Power Company with the Secretary of State with a capital stock of $40,000. The directors are J. P. Lewis, H. S. Lewis, H. L. Van Arnam, of Beaver Falls.

NEW YORK, N. Y.—The Ruhmkorf Electric Company has filed articles of incorporation with the Secretary of State with a capital stock of $100,000. The directors are Joseph Battner, of New York; Theodore Hubert, of Brooklyn, N. Y.

CHARLOTTE, N. C.—The Nottoway Hydro-Electric Company, of Petersburg, Va., has been incorporated with a capital of $150,000. The object of the company is to construct dams for the development of water power and mill sites, etc. M. R. Williams is president.

OXFORD, N. C.—The Granville Telephone Company has been chartered with a capital stock of $50,000 by E. N. Clement and others.

COLUMBUS GROVE, OHIO.—The Columbus Grove Mutual Telephone Company has been incorporated by L. B. Good and others.

DELTA, OHIO.—The Cass County Home Telephone Company has been incorporated with a capital stock of $9,750 by M. W. Briggs, D. B. Raber, F. S. Harmon and F. Briggs.

ENID, OKLA.—Articles of incorporation have been filed for the Enid City Railway Company with a capital stock of $500,000 by John J. Hall, Albert Emanuel and Charles H. Bosler, of Dayton, Ohio; Carl Cruse and W. H. Hills, of Enid.

FARGO, OKLA.—The Fargo-Harmon Telephone Company has filed articles of incorporation with a capital stock of $1,500. The incorporators are G. W. Bailey and others.

HYDRO, OKLA.—The Deer Creek Telephone Company has filed articles of incorporation with a capiaal stock of $600. The incorporators are Ira Smith and others.

McCOMB, OKLA.—The Farmers' Independent Telephone Company has been incorporated with a capital stock of $500 by R. W. Johnson and others.

WAKITA, OKLA.—The New Era Telephone Company has been incorporated with a capital stock of $20,000 to take over the telephone companies at Pond Creek and Pioneer. H. F. Wilkins is president, and S. D. Million is treasurer and general manager.

HERMISTON, ORE.—The Western Umatilla Mutual Electric Company has been incorporated with a capital of $50,000 by Jas. Fee, E. P. Dodd, and others, to supply electricity for lighting and power to the territory under the Umatilla government project. The power site is stated to have been located 2 miles west of Hermiston; the ditch flow will be 2 miles long and the plant will have sufficient capacity to furnish light and power for Hermiston, Umatilla and Echo.

MYRTLE POINT, ORE.—The Coquille Valley Power Company has been incorporated by J. R. Benson and W. W. Doyoe, of Myrtle Point; D. H. Johnson, and J. A. Davenport, of Coquille. The company has secured water rights in Coos County and will erect a power plant to generate electricity for light, heat and power and for the operation of street railways.

ALLENTOWN, PA.—The Franklin & Towamensing Electric Street Railway Company has been organized and will apply for a charter to construct an electric railway from Weissport through North Weissport and Phifer's Corner to Parryville and thence to Millport. The incorporators are A. P. Berlin, John T. Semmel, Dale Craig, H. J. Bretney

BROWNSVILLE, PA.—The Brownsville, Masontown & Smithfield Railway Company has filed articles of incorporation with a capital stock of $150,000. The incorporators are W. J. Sheldon, W. J. Dairi and C. V. Kennedy.

ELLWOOD CITY, PA.—The People's Street Railway Company has been chartered with a capital stock of $12,000. The directors are: James Campbell, president; Ganer L. Jenkins, Frank S. Christy, H. W. Mulligan and Frank Sheridean.

KENNETT SQUARE, PA.—A charter has been granted to the Kennett & Coatesville Railway Company with a capital stock of $120,000. J. Walter Taylor, of Kennett Square, is president.

NEW CASTLE, PA.—Application for a charter for the Beaver Falls, New Castle & Youngstown street car line has been published, and indicates a merger of all the proposed interurban lines between here and the two other cities named. The right of way designated is from Beaver Falls to Hoytdale and Wampum to this city. A branch line is also provided for from Wampum to Ellwood. The incorporators are: C. J. D. Stroheckler, N. B. Duncan, Jordan Johnson, M. Bliss Dewey and George Nye.

PITTSBURG, PA.—John K. Ewing, Edw. W. Rolfe and Milton D. Hays have applied for a charter for the United States Light, Heat & Power Company. The purpose of the company is said to be to construct a power house and to rent space to manufacturing concerns; also to supply the surrounding neighborhood with electricity for various purposes. The capital stock is $100,000.

SUNBURY, PA.—A charter has been granted to the Sunbury & Trevorton Electric Railway Company to construct a line from Sunbury to Plum Creek, a distance of 2½ miles. The company has a capital stock of $15,000. Monroe H. Kulp is president.

TYRONE, PA.—A charter has been granted to the Loan Light & Power Company, to supply electric light, heat and power in Tyrone. Geo. C. Wilson, of Tyrone, and Wallace Wilson, of Alexandria, are interested.

Legal.

DES MOINES RAILWAY FRANCHISES.—It is reported from Des Moines, Ia., that Judge Smith McPherson, of the United States Circuit Court for the District of Iowa, has decided that the franchise of the Des Moines City Railway Company is perpetual ,and that the Court should and will enjoin any effort to restrain the company from operating its lines under the franchise.

RESTRAINT OF TRADE.—At Philadelphia, on February 28, the United States Court of Appeals in the case of the Wheeler Stenzel Company of Boston against the National Window Glass Jobbers' Association, held that the latter violated the Sherman anti-trust law in forming an illegal combination for the restriction of trade and the regulation of prices. The decision reverses the Circuit Court, which held that the Boston firm failed to show the illegal combination. The Wheeler Stenzel Company charged the jobbers' association with controlling the output of window glass and discriminating against all dealers not mentioned on a list maintained by the association.

BLOCKING TELEPHONE MERGER.—Last week Attorney-General Jackson, on information furnished by James B. Howe, of Cleveland, and others whose names do not appear, secured from Supreme Court Justice Fitts in Albany an order restraining the consummation of a proposed agreement whereby the American Telegraph & Telephone Company, or Bell Telephone Company, was alleged to be about to take over the franchises and property of the United States Independent Telephone Company, which has its headquarters in Rochester. Joseph A. Lawson was designated as referee to take testimony upon all the alleged facts involved. The hearing is set for March 7. The Attorney-General is acting under the anti-trust law, which seeks to prevent a monopoly in restraint of trade. The United States Independent Telephone Company is the holding corporation of a large number of local independent telephone companies which have obtained franchises from different localities in the State for the purpose of competing with the so-called Bell company. Affiliated with the United States Independent Telephone Company directly are the local independent companies at Utica, Herkimer, Syracuse, Rochester, Jamestown and other intermediate places. It is alleged that negotiations for the transfer of 76 per cent of the bonds and 67 per cent of the stock holdings of the independent company had been in progress for some time through a trust company. The Stromberg-Carlson Telephone Manufacturing Company is controlled by the United States Independent Company. James B. Howe, one of those who furnished affidavits supplying the information upon which the Attorney-General is proceeding ,is the president of the International Independent Telephone Association of America and claims to represent also other independent companies.

Obituary.

MR. G. G. MARTIN.—Mr. George G. Martin, for six years district superintendent of the Bell Telephone Company in Arkansas, died February 24 at the home of his father, in Webster Groves, Mo. He had been ill for three months and was confined most of that time at his father's home. The deceased was born in New Orleans in 1871. He graduated from Smith Academy in 1889 and from Yale four years later. He represented the Bell interests in Indianapolis, Ind., for four years. He was transferred to Arkansas in the latter part of 1900.

MR. D. S. PLUME. The death is announced of Dr. David S. Plume, at Waterbury, Conn., aged 77. He was one of the oldest manufacturers of Waterbury. He was treasurer of the Plume & Atwood Manufacturing Company and the American Ring Company, besides being president of the Colonial Trust Company, president of the Thomaston National Bank, a director in the Seth Thomas Clock Company of Thomaston, a director of the Phoenix Mutual Life Insurance Company of Waterbury and vice-president and a director of the Connecticut Railway & Lighting Company. He was also a director in the old New York & New England Railroad Company, and the Naugatuck Railroad Company. Mr. Plume was one of the original owners of the old horse railroad in Waterbury and later was president of the Waterbury Traction Company, which absorbed that company.

MR. C. E. SANDERSON.—We regret to note the death of our journalistic colleague, Mr. C. E. Sanderson, manager of the *American Gas Light Journal*, one of the technical press pioneers of the country. He was born at Williamstown, Mass., April 27, 1846, and after other business experience, entered the office of the *Journal* in 1870. The following year he became its manager, remaining in that capacity until the time of his death February 20, in Brooklyn, N. Y. Few men had a wider acquaintance, and none had a larger body of friends in the gas industry than Mr. Sanderson, and the general esteem in which he was held was evidenced by the many private and public utterances of associates and societies. He married Miss E. G. Romaine in 1882, and is survived by his wife and a daughter.

MR. O. D. MUNN.—Mr. Orson D. Munn, head of the firm of Munn & Co., publishers of *The Scientific American*, died last week in New York City. He suffered from a slight stroke of paralysis a week previously. He was born on June 11, 1824, at Monson, Hampden county, Mass. When he was 22 years old he came to New York, and, with Alfred E. Beach, bought *The Scientific American*, a publication which had been founded about six months before. It was the first popular scientific journal in America, and success came quickly. Numerous requests made on the publishers for advice concerning the procuring of letters patent for new inventions led to the establishment of a patent agency, and for many years Munn & Co. have had a large amount of that class of business. More recently the Encyclopaedia Americana has been brought out successfully under the auspices of the company.

MR. E. H. LEWIS.—It is with deep regret we record the sudden death from heart disease of Mr. Eugene H. Lewis, on a street car in New York city, while on his way home to dinner, on March 1. He had been suffering from grip for three or four weeks. He was born in Wisconsin in 1852. He was prepared for college at the Beloit Preparatory School, and was subsequently graduated from Yale in 1873, and thereafter at the Columbia Law School in 1875. He was admitted to the New York bar in 1875. After several other firm connections, he formed a partnership in the winter of 1883-4 with Sherburn B. Eaton, under the name of Eaton & Lewis, and for a short time was a co-partner in the firm of Eaton, Lewis & Nicoll, the junior member of which firm was De Lancey Nicoll. Since Mr. Nicoll's retirement the firm has continued under the name of Eaton & Lewis, although Major Eaton retired from practice five years ago. The particular efforts of the firm of Eaton & Lewis with respect to litigation in electrical subjects, particularly the patents of Mr. Edison, are matters of history. Mr. Lewis knew all the American pioneers in the electrical field, both in the inventive and financial departments. Both Edison and Marconi were among his clients and his friends. He was also the witty chairman of the Electron Club, a little coterie in the University Club of New York, one of whose objects is to entertain distinguished scientists. Mr. Lewis's professional work was characterized by a scrupulous regard for the ethics of his profession. He was a member of the Bar Association, Lawyers, Yale, University, Players, Rockaway Hunt, and New York Yacht Clubs and of the Metropolitan Club of Washington. He leaves a widow, Mrs. Amy Busby Lewis, once Richard's Mansfield's leading woman in his plays, and three daughters, the eldest of whom is five years of age.

Educational.

SYRACUSE UNIVERSITY.—The February quarterly bulletin of Syracuse University, N. Y., giving very full information as to the summer school, Teachers' College, etc., is a most interesting and attractive publication. The data are put together in admirable form and manner, and the views serve excellently well in portraying the natural and architectural beauties of the place.

AGRICULTURAL COLLEGE, MISS.—The Mississippi Agricultural & Mechanical College has issued a bulletin as to its school of engineering, giving many details as to the courses in civil, mechanical, mining and electrical engineering. Views of the laboratories and work shops are shown, and each course is outlined. Power plants in the State are earnestly requested to send to the College instruments that may need calibration and repair so that the students may do that instructive work. The electrical engineering equipment is modern and includes two direct-connected units of 75 and 40-kilowatt capacity, and 22 motors of a total 185-hp capacity, both direct and alternating. Mr. C. E. Ard, B. Sc., is the professor in physics and electrical engineering.

Personal.

MR. P. T. DODGE, president of the Mergenthaler Linotype Company, has been elected a director of the American Graphophone Company.

MR. A. E. DOBBS, the telephone engineer, lectured recently at Purdue University on lightning, its peculiarities and methods of protection. The lecture was highly practical and suggestive.

MR. W. HILL, president of the Colliers Company, has been elected president of the Farmington River Power Company, to succeed the late Mr. C. H. Sears.

MR. GEORGE E. BENNETT, district manager, 237 Vermont Street, Buffalo, N. Y., will hereafter represent the Bay State Lamp Company, of Danvers, Mass., in northern New York.

MR. J. M. FROST, who has been superintendent of the Viles electric plant at Montpelier, Vt., has resigned to accept a position with the Ingersoll-Rand Company.

MR. C. O. BAKER, president of Baker & Company, Inc., the platinum refiners, etc., has left New York for a West Indian cruise on the steamer "Blucher," and will be gone on this voyage in Caribbean waters until early in April.

MR. P. E. RISHEL has resigned his position as Pennsylvania representative of the Metropolitan Engineering Company of New York City and is now connected with the National Electric Time Switch Company, with offices at 335 Fifth Avenue, McKeesport, Pa.

MR. W. H. ZIMMERMAN has resigned his position as general manager of the De Kalb-Sycamore Electric Company, to accept a similar position with the Michigan Power Company, at Lansing, Mich. The latter corporation expects to enlarge its present property by constructing an auxiliary steam plant, and to make further developments of the water power on the Grand River.

MR. E. A. WILLIAMS.—Mr. E. A. Williams, general mechanical superintendent of the Erie Railroad, has resigned to engage in other business, his resignation taking effect March 1. The office of general mechanical superintendent is abolished.

Mr. F. E. FITZPATRICK, manager of the Sacramento Electric, Gas & Railway Company, Sacramento, Cal., has resigned his position to become general manager of the Bay Counties Power Company, of San Francisco, Cal. Mr. Fitzpatrick will be succeeded by C. W. McKilip, who has long been with the company.

J. A. BENDURE, of Lockport, N. Y., for the last year general manager of the Economy Light, Fuel & Power Company, Lockport, N. Y., has resigned to take the position as general manager of the Economic Power & Construction Company, of Buffalo, which will install a steam-heating plant in that city. A. W. Wicks, of Chicago, will succeed Mr. Bendure.

DR. A. HAMMERSCHLAG.—At the celebration of Washington's birthday, at Lehigh University, South Bethlehem, Pa., the honorary degree of doctor of science was conferred on Arthur Arton Hamerschlag, director of the Carnegie Technical Schools of Pittsburg, Pa. The orator of the day was the Hon. W. U. Hensel, of Lancaster, Pa., ex-attorney general of Pennsylvania.

MR. C. E. WARNER having accepted a position, in charge of some of the work of the Federal Construction Company, requiring all his time and attention, he has decided to close his office at 60 State Street, Boston, and retire from the business in which he has been engaged there. His address is now care of the Federal Company, 35 Congress Street, Boston, and Rockingham, N. C.

MR. J. J. SHIPLEY, chief of construction of the Cuyahoga Telephone Company, Cleveland, Ohio, has resigned his position to become state agent of the United Surety Company, in connection with James B. Hoge, secretary of the National Interstate Telephone Association, under the firm name of Hoge & Shipley. A. S. Hillhouse, exchange manager of the Cuyahoga Telephone Company, has been appointed assistant general manager and will assume the duties that have been performed by Mr. Shipley. Mr. Hoge will retain his connection with the telephone work.

MR. A. W. K. PEIRCE has resigned his position as consulting electrical engineer to the Consolidated Gold Fields of South Africa Lim., in order to take up the position of general manager of the Victoria Falls Power Company Limited. He is now located in London at 2 London Wall Buildings, arranging various matters in connection with the company's enterprise. Although the ultimate object is to develop electrical energy at the Victoria Falls, on the Zambesi River, the present intention is to erect a steam power plant on the Witwatersrand, where a large demand already exists. The company has acquired the two Rand plants now in existence and hopes to have the new plant going by July, 1908. Details have already been given for the plant ordered from the Allgemeine Elektricitaets Gesellschaft, comprising six 3,000-kilowatt, 7,000-volt, 50-cycle turbo-alternators for the new power station and three 500-kilowatt turbines for supplying energy for all the auxiliaries used in the plant, these latter turbines being coupled to 440-volt direct-current generators and the exciters.

L. W. CADY.

MR. LAWRENCE W. CADY, who was formerly designing engineer with the Simplex Electric Heating Company, has resigned his connection with those interests to join the engineering staff of the W. J. Barr Electric & Manufacturing Company, of Cleveland, O., makers of several well-known varieties and specialties in the electric heating field. Mr. Cady's early electrical training and education was acquired at the Drexel Institute, Philadelphia. Later on he formed and was senior member of the firm of Lawrence W. Cady & Brother, contracting electrical engineers, but after it was well established he withdrew to enter the service of the General Electric Company. He next associated himself, after three or four years' experience, with the Simplex Company, and now becomes chief electric engineer for the Barr concern, to which he takes not only a valuable fund of experience and information, but considerable skill as a designer and inventor.

Trade Publications.

AJAX LINE MATERIAL is treated very thoroughly in the Specialty Catalogue No. 1, just issued by the Ajax Line Material Company, of 12 and 14 South Jefferson Street, Chicago. There are 20 illustrated pages of text, with prices and other data.

ALTERNATORS.—The Allis-Chalmers Company, of Milwaukee, Wis., has issued a reprint of its bulletin No. 1038 on the subject of alternating current generators. It contains pictures of the apparatus and a number of views of plants in which the machines are installed.

DIAL CONTROLLERS.—Bulletin No. 4476 of the General Electric Company, Schenectady, N. Y., deals with dial-type controllers designed to operate motors for printing presses and machine tools. Each controller is provided with a no-voltage release and is intended for use with shunt and compound-wound motors.

DOSSERT & CO., INC., 242 West Forty-first Street, New York City, have issued a neat illustrated pamphlet on their solderless electrical connectors or cable joints for standard or solid wire. Full details are given as to the operation of this simple and effective system.

TWO JACKS.—The Monarch Electric Mfg. Co., of Warren, Ohio, has issued in novel form an artistic little booklet entitled "The Tale of Two Jacks," one of whom was lampurse and the other wasn't. Other pieces of literature deal with the Monarch special lamps and varieties, particularly the "Prismo" clusters and radiators or reflectors. Prices are quoted. All this descriptive matter is sent free on request.

DIELECTRIC MFG. CO., St. Louis, has just issued bulletins Nos. 1 and 2, which begin a series to be brought out by the Dielectric Manufacturing Company in connection with its line of insulating varnishes, paints and compounds. Bulletin No. 1 illustrates the chemical and electrical laboratory of the company, and discusses problems of modern coil impregnation. Bulletin No. 2 presents in tabular form data relative to the various products made by the concern, and the uses to which they are put.

THE "EXIDE" BATTERY INSTRUCTION BOOK has just been revised by the Electric Storage Battery Company. The 1907 book is most complete and describes the various parts comprising the "Exide" battery and gives in detail the method of operating and caring for the battery as well as instruction for assembling and putting it in commission. The book is not for sale, but is being distributed by the vehicle manufacturers, the "Exide" battery depots, and the "Exide" distributors, which are located in the principal cities throughout the country. Upon request it will be furnished by any of the branch sales offices of the Electric Storage Battery Company.

HABIRSHAW WIRES AND CABLES.—The India Rubber & Gutta Percha Insulating Company has just issued a very neat and compendious handbook of its famous Habirshaw wires and cables. It is replete with various information and data—addition table for extra braids, cotton or paper wrapping, 30 per cent of Para compound; flexibles; lead coverings; synopsis of rules; comparison of copper gauges, and bar prices from 17 to 28 cents inclusive. A desirable feature is found in the code prices given on the various copper bars. Mr. J. B. Olson, the general sales manager, says: "In the past, when prices have fluctuated, with each advance we have had a list of prices printed, representing the prevailing bar. This has frequently involved delay in the sending out of quotations to our customers. With our new book to refer to for latest code prices, this annoyance will be obviated." A large edition has been printed, and copies are obtainable on application.

FANS, BLOWERS AND EXHAUSTERS are described in a 96-page book recently published by the Green Fuel Economizer Company, of Matteawan, N. Y. Dimensions are given for 290 sizes and types of steel-plate fans for heating and ventilating, drying, mechanical draft, etc., for 27 sizes and types of planing "mill exhausters" for handling shavings, wool and other light materials, and also for a line of steam and hot-water heating coils. Typical installations, containing some of the largest fans ever built, are described in detail. In addition, there are over 20 pages of tables and data relating to air-moving engineering. The table of capacities, speeds and horse-powers for steel plate fans has been recalculated throughout and several errors contained in the older table in general use have been corrected. This book will be sent gratis to engineers and others interested in the subject.

BUCKEYE GEM LAMPS.—A handsome and interesting circular has been issued by the Buckeye Electric Company, of Cleveland, O., with reference to its "Gem" metallized 50-watt lamp. The first part of the pamphlet gives a general description and the second part gives an elaborate cost analysis. As is well-known, the consumption of the lamp is 2.5 watts per candle, or a saving of 20 per cent. in energy, as compared with the ordinary incandescent. The lamps are made to operate equally well on both direct and alternating circuits, and between 100 and 130 volts. The light is of admirable quality as to brilliancy and steadiness. The cost renewals figure out from ¼ to ¾ cent per kilowatt-hour depending upon the efficiency at which they are operated. The cost analysis given in the bulletin is an excellent piece of work, and brings out clearly the elements favorable to the high efficiency lamp of this type.

Business Notes.

THE FT. WAYNE ELECTRIC WORKS, of Ft. Wayne, Ind., has appropriated $1,500,000 for the purpose of constructing a large addition to the plant and for new equipment which will double the capacity of the works.

ENAMELED METALS COMPANY.—Mr. William S. Brown, 3 West 29th Street, New York, announces that he has arranged with the Enameled Metals Company, of Pittsburg, Pa., to act as its eastern sales agent. He now carries a complete stock of "Pittsburg Standard" enameled rigid conduit. Mr. W. A. Treadwell is connected with Mr. Brown's office.

MR. G. F. ARCHER, 39 Cortlandt Street, New York, has lately completed a wiring installation for the electrotyping plant of P. F. Haggerty, New York, including eighteen motors driving the different machines, and a 20-hp plating outfit.

THE FRANKLIN ELECTRIC MFG. COMPANY, Hartford, Conn., has leased the Davis-Merriman property on Hubbard Street, Middletown, in order to provide more room for its increasing business. The company will operate the Middletown establishment in addition to its present factory in Hartford. It is expected to have the Middletown plant in operation about June 1.

MR. S. SILVERBERG has opened an office in the Knickerbocker Building, Thirty-eighth Street and Broadway, New York City, as a dealer in electrical apparatus, as general agent. He will also deal in new and second-hand electrical therapeutic instruments. He is desirous of getting into touch with manufacturers of these goods and of general electrical supplies, and invites correspondence. Mr. Silverberg has had an experience of twelve years in Washington, D. C.

FREDERICK PEARCE CO., 18 and 20 Rose Street, New York City, bought out the electrical instrument business of the Willyoung & Gibson Co. about a year ago. Since then the Pearce Company has provided additional facilities in the way of space and equipment for turning out a full line of instruments of precision for measurement purposes, electro-therapy, etc. The firm also invites inquiry as to all lines of electrical supplies and is ready to undertake the development of new ideas and inventions.

PORCELAIN INSULATORS.—Larrabee & Nichols, of Bennington, Vt., the owners of the patents, have issued recently the following notice: "The Porcelain Electrical Manufacturing Company, of Trenton, N. J., is no longer making the P. E. M. Co. Knob, which is the two-piece porcelain insulator formerly known as the 'W. E. Split knob.' The R. Thomas & Sons Company, 39 Cortlandt Street, New York City, now has the exclusive right to make and market this insulator and will give all orders prompt attention. The insulator will now be known as the 'Thomas T. P. I. Knob' and being the only two-piece interchangeable knob on the market—any two pieces making a complete knob—we expect with increased facilities, right prices and careful attention to all orders to very largely increase the use of this insulator where economy and appearance are factors in the installation of electrical work of all kinds."

"BLUE RIBBON" DRY CELL. The William Roche Dry Battery Company, 288 Clerk Street, Jersey City, N. J., has recently put on the market a new dry cell called the "Blue Ribbon." This new type is built by Mr. Roche in glass jar, and is meant especially for work in damp and wet places. It is made up in two styles, one of which is said to be "charged," i. e. the whole cell is given a proper percentage of moisture and is chemically charged and tightly sealed, ready for use. The other style is the "semi-charged" type, which is ready when a tablespoonful of clean water is poured into the vent, and which starts again with renewed vigor on the simple addition of a second spoonful of water. These cells are supplied put up in oak boxes containing eight and in watertight barrels that hold seven, both being portable and handy. These are applicable for motor boats, while another type for automobiles has the jar of pressed watertight paper. The parts of the cell also involve novel construction. Mr. Roche employs a spiral corrguated zinc ribbon giving about 120 inches of exposed surface or edge action, as well as about 62 inches of flat surface action, as both sides of the zinc are exposed to the action of the positive electrolyte or solution. Mr. Roche, in view of the large amount of active surface, and the high insulating qualities of the glass jar, believes that this new "Blue Ribbon" type is destined to become absolutely dominant in five years.

A RAILROAD NIGHT.—"Railroad Night" of the Technical Publicity Association was held Feb. 28, at the rooms of the Aldine Association, New York. New members were elected representing Harrison Bros. & Co., Philadelphia; Joseph Dixon Crucible Co., Jersey City; the Lunkenheimer Co., Cincinnati; Manning, Maxwell & Moore, New York; Traylor Engineering Co., New York, and Triumph Electric Co., New York. G. M. Basford, assistant to the president of the American Locomotive Co., a member of the T. P. A., presented a paper on "Progress in Transportation." W. H. Boardman, editor of the "Railroad Gazette"; J. B. Meek, manager of the railroad department of H. W. Johns-Manville Co., and R. V. Wright, editor of the "American Engineer & R. R. Journal," were guests of members. George A. Cullen, general passenger agent of the Lackawanna R. R., gave an informal address in which he pointed out that the initials T. P. A. stood for the traveling passenger agent, who in the old days was the active advertising department of a railroad.

W. S. BARSTOW & COMPANY.—Among recent additions to the organization of W. S. Barstow & Company, of New York, Montreal, and Portland, Ore., necessitated by the demands of their rapidly extending business, is a considerably enlarged draughting department. At the head of the department is Mr. Thomas Richardson, who has had wide experience in power plant design, and while connected with the Westinghouse Church Kerr & Company was closely identified with the design of the Kingsbridge power station of the Metropolitan Street Railway of New York, also the Long Island City and Harrison power plants of the Pennsylvania Railroad. Associated with him and in charge of steel structural designing is Mr. Harold S. Richmond, who, graduating with the degree of C. E. from the Norwich University of Vermont, supplemented by a post graduate course at the Thayer School of Civil Engineering of Dartmouth College, has been connected with the Boston Bridge Works, Riverside Bridge Company, and subsequently as assistant engineer in the bridge department of the Boston & Maine Railroad, Boston, Mass., and latterly with the structural department of the Westinghouse Church Kerr & Company. The draughting force numbers about 30 men well versed in all branches of engineering, their experience being gained with some of the largest engineering firms in the United States.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED FEB. 26, 1907.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 140 Nassau St., N. Y.]

845,048. STORAGE-BATTERY PLATE; Joseph Bijur, New York, N. Y. App. filed Aug. 14, 1906. A battery-plate, comprising a plurality of active strips provided with registering holes and a supporting and inclosing framework having rods cast from the frame on to the strips in said holes.

845,051. ELECTRIC RESISTANCE APPARATUS; Rolf Von Brockdorff, Bregenz, Austria-Hungary. App. filed Dec. 6, 1906. Flexible metallic tubing made of the usually spirally wound steel strips is utilized as the resistance element through which the current spirally flows. Water is passed continuously through the interior of the tube to carry away the heat.

845,053. INCANDESCENT LAMP BULB; David F. Campbell, Vancouver, British Columbia, Canada. App. filed Nov. 15, 1904. An incandescent lamp having a substantially dish or saucer shape with three tripod arms from its concave side by which it is supported. The purpose is to get a more efficient illumination from the filament.

845,056. TELEPHONE SYSTEM; Elmer R. Corwin, Chicago, Ill. App. filed Oct. 20, 1906. Details of a telephone system having a cord circuit including condensers in the talking wires thereof.

845,062. TELEPHONE-TRANSMITTER; James M. Dempsey, Chicago, Ill. App. filed Nov. 30, 1906. A form of transmitter having a multiplying lever connection between the diaphragm and the microphone contacts.

845,077. TELEPHONE TRUNKING SYSTEM; Harry C. Goldrick, Indianapolis, Ind. App. filed Sept. 17, 1902. Complete diagram of cord circuits for trunking exchange system.

845,101. POLARITY INDICATOR; Paul Leo, Elizabeth, N. J. App. filed Mar. 9, 1906. A permanent magnet is pivoted to constitute a lever and a pair of electromagnets attract the poles thereof according to the direction of the current tested.

845,126. MAGNETIC CLUTCH; Alfred W. Saville, Chicago, Ill. App. filed Feb. 24, 1906. The clutch has annular grooves to receive the magnet windings, and the arrangement is such that the current which magnetizes one end of the clutch de-magnetizes the other end.

845,153. TELEGRAPH SOUNDER; Dennis A. Whitney, Holland, N. Y. App. filed Nov. 15, 1906. An ordinary main line relay is utilized as a sounder. Has a pair of bells against which the armature strikes to increase the magnitude of the sound.

845,157. COMPOSITE TELEPHONIC AND TELEGRAPHIC CIRCUIT; George M. Yorke, New York, N. Y. App. filed Jan. 7, 1907. Detailed diagram of circuits for transmitting telephone and telegraph messages from a single pair of line wires.

845,188. RAILWAY SIGNAL SYSTEM; Francis M. Myers, Windsor, Mo. App. filed Mar. 22, 1906. Has plates spaced along the roadway and with which specially constructed spring shoes on the train contact. The shoes have a mechanical connection by which their movement closes a special circuit in the locomotive.

845,219. ELECTROTHERMAL CUT-OUT; Frank B. Cook, Chicago, Ill. App. filed Apr. 16, 1906. A pair of spring blades are held together by a graphite element having wax or like material at its junction with the springs. When the graphite heats by the passage of the current, the wax melts and allows the blades to separate.

845,220. BLOCK SIGNAL SYSTEM; Fred B. Corey, Schenectady, N. Y. App. filed Feb. 16, 1904. A complete block system having danger and caution signals and in which alternating currents are used and in which all the advantages of direct current system without wires may be obtained.

845,225. RESISTANCE UNIT; Richard Fleming, Lynn, Mass. App. filed Jan. 26, 1906. A resistance element in the form of a fabric or mat woven of resistance wire and special porcelain buttons.

845,236. CUT-OUT; Edward M. Hewlett and Charles H. Hill, Schenectady, N. Y. App. filed May 2, 1904. In order to indicate audibly or visually the condition of some remote or concealed apparatus of a cut-out, patentee has a special push button which is automatically pressed to complete an alarm circuit when the circuit breaker opens and which may be manually or automatically returned to normal position.

845,252. RING FOR CONNECTING WIRES; Ralph E. Noble, Chicago, Ill. App. filed Sept. 1, 1906. In order to provide a cheap and efficient way of joining the trolley wires at a turn-out, patentee has a ring to which the trolley wires are hooked. This ring centers or guides the trolley wheel in passing from one wire to another.

845,268. SPRING TERMINAL CLIP; John Schade, Jr., Brooklyn, N. Y. App. filed Apr. 28, 1905. A binding post or a terminal having a pair of plates spring pressed apart from one another. One has a loop entering a hole in the other so as to engage and hold a terminal wire in spring clamped relation.

845,281. ELECTRICALLY OPERATED VALVE; Leonard A. Tirrill, Lynn, Mass. App. filed Sept. 8, 1904. Device for opening and closing a valve at a distant point. The valve is opened and closed by a motor having a Geneva stop motion device whereby the motor operates to fully close or open the valve when it has once been started into action.

845,282. TELEPHONIC-CURRENT REINFORCER OR REPEATER SYSTEM; Nathaniel G. Warth, Columbus, O. App. filed Apr. 23, 1906. In a telephone-repeater, twin local circuits embracing a current-

supply and a transmitter in repeater relation to a receiver, together with means for operating the receiver from and the transmitter to the line inductively.

845,288. SWIVEL TIP FOR ELECTRIC CONDUCTORS; William F. Barker, Somerville, Mass. App. filed Apr. 17, 1906. The end of a piece of flexible wire or cable is fitted with a metallic thimble enclosing a rod having a head or button. The latter is received among the wires of the flexible cable so as to form a swivel connection therewith.

845,316. MEANS FOR RECEIVING INTELLIGENCE COMMUNICATED BY ELECTRIC WAVES; Greenleaf W. Pickard, Amesbury, Mass. App. filed Nov. 23, 1906. Form of detector for a wireless receiving circuit.

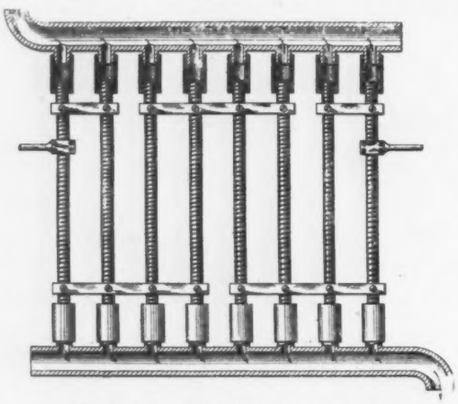
845,323. TROLLEY POLE; Charles F. Wensinger, Fremont, O. App. filed Oct. 31, 1906. The trolley wheel is swiveled on a horizontal platform which is constantly maintained in such horizontal relation by a pair of trolley poles constituting virtually a parallel link motion.

845,328. PARTY-LINE LOCK-OUT; Mark P. Boone, Peru, Ind. App. filed Jan. 27, 1906. In a party-line telephone, the combination, with the talking-circuits thereof consisting in part of a pair of separable terminals, and means normally controllable by the user for permitting engagement of said terminals, of electrically-controlled means for preventing contacting of said terminals, a switch in series with said terminals, and a condenser bridging said switch.

845,391. NEGATIVE POLE-PLATE; Joseph Bijur, New York, N. Y. App. filed Apr. 5, 1906. The process of treating plates adapted for use as negative-pole plates which consists in soaking the plate in a solution capable of penetrating the pores of the plate and there depositing an inert substance.

845,452. TELEPHONE TRUNKING SYSTEM; Francis W. Dunbar, Chicago, Ill. App. filed Aug. 23, 1902. Diagram of cord circuits for a central exchange system.

845,455. APPARATUS FOR REMOVING HAIRS; Manley G. Fowler, Rochester, N. Y. App. filed Nov. 13, 1906. A flexibly supported arm has a circular plate universally jointed to the end thereof which



845,051—Electric Resistance Apparatus.

is perforated to receive the plugs of the various needle circuits.

845,476. SWITCH MECHANISM FOR ELECTRIC LAMP SOCKETS AND THE LIKE; James P. Neilson, Bridgeport, Conn. App. filed July 25, 1906. The cam or block is mounted on the spindle of the key so as to have a lost motion relation therewith, but a pair of resilient wires connect the two so that the block is spring held at its middle position.

845,496. INSULATED RAIL JOINT; George W. Whiteman, Philadelphia, Pa. App. filed Sept. 14, 1905. A form of rail joint having specially constructed fish plates with inclined channels or cavities on their inner faces which co-operate with weighted blocks to tightly clamp the rails and at the same time permit longitudinal adjustment.

845,497. INSULATED RAIL JOINT; George W. Whiteman, Philadelphia, Pa. App. filed Apr. 11, 1906. Relates to modifications of the above.

845,522. AUTOMATIC SIGNAL ATTACHMENT FOR TELEGRAPH REGISTERS; John C. Carmody and Walter K. Pulsifer, Fitchburg, Mass. App. filed Apr. 28, 1906. In order to show when a telegraph register is receiving a message, patentee has an automatically illuminated lamp which is displayed as long as the message is being written and which serves the double function of an indicator, and an illuminating source for reading the message.

845,528. CONTROLLER; William Cooper, Cincinnati, and Charles W. Johnson, Norwood, O. App. filed Oct. 13, 1903. Details of construction of a controller of the type in which separate high potential and low potential third rails are used for getting the voltages for different speeds.

845,533. TELEPHONE SYSTEM; William W. Dean, Chicago, Ill. App. filed Feb. 7, 1903. Relates to a telephone line having a plurality of testing contacts and special testing circuits therefor.

845,542. INCANDESCENT LAMP SOCKET; Gilbert W. Goodridge, Bridgeport, Conn. App. filed May 17, 1906. A form of connection between a canopy or box and a conduit pipe. A threaded bushing is longitudinally slotted or split and a conical cap is adapted to bind the bushing tightly on the threads of the conduit pipe.

845,543. ELECTRICAL ATTACHMENT PLUG; Gilbert W. Goodridge, Bridgeport, Conn. App. filed Jan. 7, 1907. A form of cut-out plug having split studs in one member which enter tubular terminals in the other member or part.

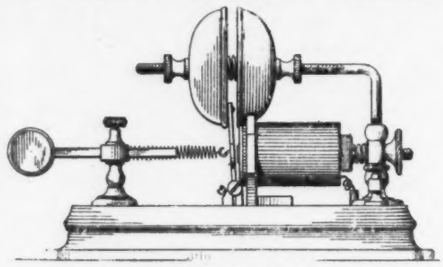
845,544. WIRING KNOB; Waldo C. Gordon, Windsor, Vt. App. filed Nov. 20, 1905. Two cylindrical blocks of porcelain are fastened together by a large central screw and clamp on the wire by grooves which register for the two blocks.

845,546. TELEPHONE-MAGNET; Aaron E. Harrison, New York, N. Y., and Crowell M. Haslett, Jersey City, N. J. App. filed Sept. 9, 1905. A telephone-magnet, comprising a plurality of magnetic members, pole-pieces connected therewith, and spool ends mounted upon said pole-pieces and inclined relatively to the general length thereof.

845,553. GAS LIGHTER FOR AUTOMOBILES; George Kapp, Greenwich, Conn., and Gustavus A. Alviset, Port Chester, N. Y. App. filed Feb. 28, 1906. In order to conveniently light the acetylenes of an automobile, patentee has an ignition circuit from the usual spark coils and which may be operated by a special push button.

845,585. CARBON ELECTRODE AND THE METHOD OF PRODUCING THE SAME; Truman P. Sharts, Readsboro, Vt. App. filed Mar. 6, 1906. A process of forming charcoal-carbon electrodes comprising the igniting and burning of petroleum, limiting the burning petroleum to one place and collecting the carbon products of combustion in steps to form a substantially integral mass.

845,609. ELECTRIC CONDUCTOR; Sidney G. Brown, London, England. App. filed June 16, 1902. In order to overcome the effect of



845,153—Telegraph Sounder.

capacity in a submarine cable, patentee has a spirally wound conductor embedded in the insulation of the cable and which has enough inductance to balance the capacity thereof.

845,614. POT HEAD; William Callahan, South Bend, Ind. App. filed May 10, 1905. Outlet box or junction for joining overhead wires to submarine conduit or cable. The inside of the box is deformed so as to form a water shed and prevent ingress of moisture to the wires of the cable.

845,618. AUTOMATICALLY OPERATED LIQUID RHEOSTAT; Coloman DeKando, Budapest, Austria-Hungary. App. filed May 6, 1905. A series of metallic plates are supported in vertical relation above a tank of feebly conducting fluid and this fluid is impelled to cover more or less of the plates by compressed air.

845,629. BURGLAR ALARM; Joseph Gaynor, Barre, Vt. App. filed Aug. 25, 1906. A man trap is provided in the floor of the dwelling to be protected and the hinge thereof completes an alarm circuit.

845,655. AUTOMATIC CIRCUIT BREAKER; Harry W. Leonard, New York, N. Y. App. filed Mar. 21, 1901. Relates to circuit breakers of the type in which one or more switches are operated automatically whenever circuit conditions vary beyond certain limits. Has potential coils and current coils acting on the same tripping devices.

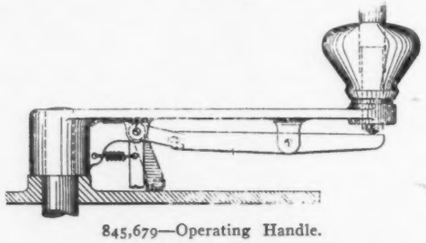
845,656. ELECTRIC CIRCUIT CONTROLLER; Harry W. Leonard, Bronxville, N. Y. App. filed Apr. 6, 1906. Mechanical and electrical means for preventing the improper manipulation of rheostats and controllers by which arcs are drawn at the initial contacts thereof.

845,670. VACUUM APPARATUS; Percy H. Thomas, East Orange, N. J. App. filed Jan. 23, 1904. The method of removing injurious gases from a chamber, which consists in causing a vapor to pass through the said chamber thereby removing a portion of the original gases or vapors, continuing this process to any desired limit, and sealing off both the inlet and outlet of the said chamber.

845,671. MEANS FOR CREATING A VACUUM; Percy H. Thomas, East Orange, N. J. App. filed June 14, 1904. The method of creating a high bacuum in an inclosed chamber containing mercury, which consists in inclosing in the said chamber a material capable of forming a gas-absorbing amalgam with mercury, separating it from the mercury in the chamber, exhausting the chamber by any approved process, and afterward bringing the said material into contact with the mercury and causing an amalgamation thereof.

845,679. OPERATING HANDLE; Erich Beck, Schenectady, N. Y. App. filed Mar. 21, 1906. The controller handle has a detent operated by a button projecting through the knob. This detent permits only step by step movements of the controller arm to start the motors, but may be moved through its entire range to open the circuits.

845,682. CAR MOTOR; Benson Bidwell, Chicago, Ill. App. filed July 5, 1906. The armature of the motor has a hollow shaft through



845,679—Operating Handle.

which air is impelled into the interior of the motor for cooling purposes.

845,683. SIGNALING SYSTEM FOR ELECTRIC RAILWAYS; Charles P. Breese, Norfolk, Va., and Adoniram J. Wilson, Westfield, N. J. App. filed May 5, 1902. The trolley is sectional and each section has a feeder connection through a relay magnet. The power current is thus utilized for the operation of block signal apparatus.

845,712. ATTACHMENT PLUG; Charles J. Klein, New York, N. Y. App. filed Apr. 21, 1906. Details of construction of an attachment plug having porcelain and sheet metal parts assembled together by a limited number of machine screws.

845,723. FEED WATER PURIFIER; Charles Timmerman, New York, N. Y. App. filed Mar. 31, 1906. A tank or receptacle through which the water is passed has plates by which the fluid is compelled to traverse a zig-zag path. These plates are oppositely electrified so as to pass a current through the water.

845,731. CURTAIN HOISTING APPARATUS; Theodore Eskilsson, New York, N. Y. App. filed Apr. 23, 1906. Controlling system for the motors of a curtain, arranged with suitable stop motions in the manner of an elevator circuit.